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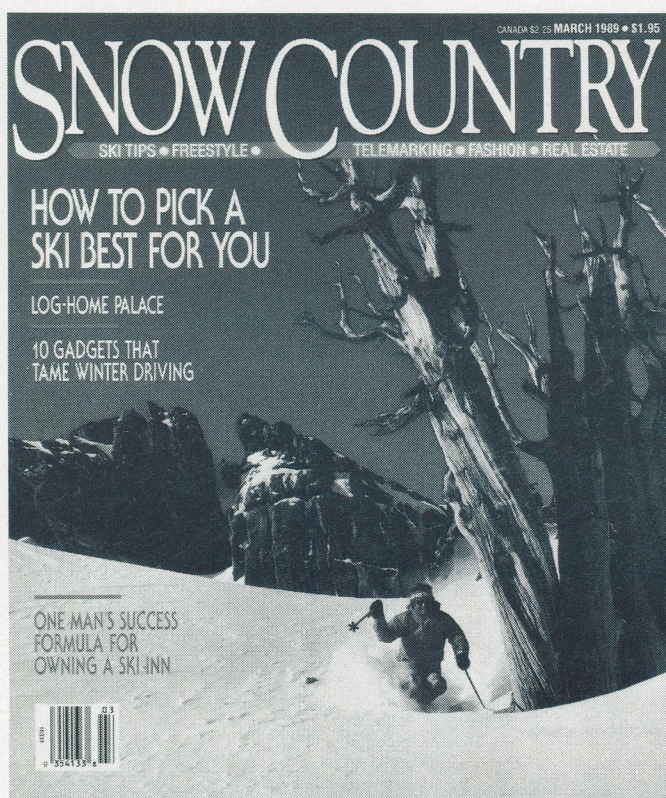
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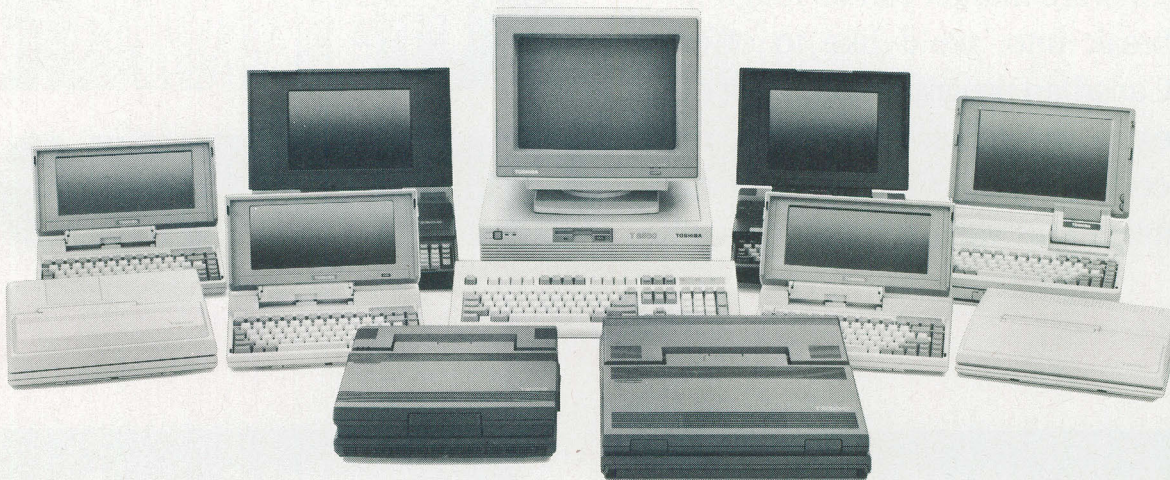
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GREAT

We at Toshiba Information Systems sincerely believe in Canadian creativity and programming expertise. Realizing that the software market can be tough to break into, we'd like to offer Canadian programmers a bit of extra incentive. Therefore, in collaboration with Moorshead Publications we are announcing the:

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WIN

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One grand prize winner will receive a complete Toshiba T1000 portable computer system.



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Ten runners-up will receive official Toshiba sweatshirts.

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Prizes may not be exactly as shown.

HERE'S HOW

This contest is open to all residents of Canada. The rules are simple:

- Send us your program on any type of PC format disk. It should be an MS-DOS EXE or COM file, created with the language system of your choice, and not larger than 64k. Windows™ programs are allowed. You retain all copyright; we just want to see what you've done. We are requesting a limit of one submission per person.
- Deadline for entries is January 1st, 1991. Winners will be announced in the February issues of the following Moorshead publications: Computing Now!, Computers in Education, Electronics & Technology Today and Business Computer News.
- The judges' decision will be final. Entries will be judged on their real-world usefulness, originality, speed and on all other factors that would concern their intended users.

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ELECTRONICS & TECHNOLOGY TODAY!

Canada's Magazine for High-Tech Discovery

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Volume 15, Number 8

October, 1990

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Technology. It has a nice ring to it, doesn't it. It comes from the Greek word, *tekhnologia* meaning "systematic treatment."

Too often, we ordinary people seem to be divorced from the latest developments in technology, electronics and science. We may hear about them, but we don't participate in them. But if that's the case, we're missing a lot. Technology is fun! And after all, when all is said and done, isn't that what life is really about?

Oops! Looks like I'm straying ever so slightly from the realm of science to philosophy. I'd better watch myself. [Slap] [Slap] Thank's, I needed that.

So let's grasp, understand and use technology to its fullest. It's not just for scientists and technicians — it's for us!

In each issue, I will try to make exciting new technological advances available to all of us. Again, I would appreciate your help. Send projects, articles, questions and/or suggestions. Maybe an open forum on technology would be a good idea. If you like this idea, send some questions or opinions and we'll devote a page to them and next month we'll print some responses and more questions. There are many possibilities.

So please enjoy this issue, and if you think you'd like to help me make this magazine still better — go right ahead.

Chuck Ander

Chuck Ander

Editor

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Reciprocal Frequency Counter/Tachometer

ZTEST Electronics Inc. is pleased to announce the introduction of the MYOUNG RFC-1300T Reciprocal Frequency counter/Tachometer. Myoung is a leading Korean electronics manufacturer. They have recently introduced a new line of low cost test equipment, including the RFC-1300T.



The Myoung RFC-1300T is an 8 digit counter with three channels: a 100 MHz range, a 1.3 GHz range and a third channel for RPM from a tachometer. The RFC-1300T measures frequency, period, RPM, linearity and totalizes. It comes complete with a TP-1300 Tachometer Probe (also available separately). Basic sensitivity is 50 mV into 1 Mohm for the 100 MHz channels and 25 mV into 50 Ohms for the 1.3 GHz channel. For the first time in a low cost meter, the advantage of reciprocal counting is available. Reciprocal techniques accurately measure low frequencies by measuring the period and displaying the result as a high resolution frequency (1 over the period). Self-test and the ability to "Hold" a reading are standard. The case is all metal and the carry handle doubles as a tilt-bail for bench use.

Contact: ZTEST Electronics, 1305 Matheson Blvd., Mississauga, Ontario L4W 1R1 (416) 238-3543.

U.S. Scientists Invent Process for Making "Smart" Optical Glass

TUCSON, AZ, July 23, 1990 — A team of U.S. scientists privately funded and working outside the major institutions, today announced a major advance in optical technology that could revolutionize telecommunications, computing, and traditional optical products. Organized by ISOTEC Limited Partnership, the team has in-

vented a process for the reliable and repeatable manufacture of "smart" optical glass and lenses. Made from gradient refractive index (GRIN) material, "smart" optical material can bend, join, divide, direct, and guide light beams in a predictable, integrated manner.

"This is an enabling technology; it will lead to 'smart' lenses and can lead to the optical equivalent of the integrated circuit in electronics," said Prof. Richard Blankenbecler, head of the Theoretical Physics Group at the Stanford Linear Accelerator Center and a consultant to ISOTEC. "The manufacturing process is straightforward and commercially viable."

With appropriate resources, ISOTEC's technology could increase dramatically the carrying capacity of fibre-optic cable for the telecommunications industry. It also promises to be an enabling technology for optical computing in which photons — without mass, generating little heat, and travelling at the speed of light — would replace electrons in integrated circuits.

A goal that has long eluded bigger and better funded efforts, the ISOTEC achievement took five years at a cost of less than \$6 million. ISOTEC CEO and founder Leslie Danziger attributes the firm's success to its unconventional approach. "We added to traditional materials science a theoretical physics approach," she explained. "Working from a mathematical description for the arrangement of atoms that would control the light inside the glass, we discovered a process for making "smart" optical glass from basic GRIN material."

Contact: Leslie Danziger, ISOTEC, 6735 Camino Padro Isidoro, Tucson, AZ 85718 (602) 297-9102

MicroTouch Announces the UnMouse for PCs

WILMINGTON, MA August 29, 1990 — MicroTouch Systems today introduced the PC UnMouse, an alternative input device designed to replace a mouse or trackball. The compact touch-sensitive tablet combines three input devices in one by providing faster cursor control, enhanced keypad functions and stylus-based graphics capabilities. This unique combination offers users



greater input power while conserving space.

The UnMouse tablet itself only measures three by four and a half inches and remains stationary beside the keyboard. It is unusually intuitive as there is no intermediary device to locate, move and manipulate; with the UnMouse, all you do is point with your finger. To move the cursor, you simply slide your finger over the glass tablet and click the "mouse button" by pressing lightly on the tablet.

The UnMouse can be used as a function keypad with well-labelled templates which slide under the glass tablet. The keypad has 16 keys, 12 of which are programmed to emulate the PC function keys. The other four act as alternative Shift, ALT, Control and Enter keys. Templates for several popular programs such as WordPerfect and Lotus 1-2-3 are included, as well as blank templates and software so that users can program their own keystroke combinations and print their own templates.

The PC UnMouse has a Serial RS-232 interface and is compatible with IBM PC, XT, AT, PS/2 and compatible machines. It comes with a driver for both mouse-driven DOS programs, as well as Windows programs. The retail price of the UnMouse is \$235 and is available through computer dealers or by calling MicroTouch directly.

Contact: MicroTouch Systems, Inc., 55 Jonspin Road, Wilmington, MA 01887 (508) 694-9900.

Device Neutralizes Video Monitor Radiation

ROHNERT PARK, Calif., Aug. 27 — A silent, hand-sized electronic unit that sits quietly atop a video monitor while eliminating the harmful effects of CRT screen radiation was announced here

today by Jim L. Lee, president of Zenion Industries, Inc.

The unique device — called the Screen ELF, for Electronic Limiter of Field radiation — uses a “pulsed plasma field” to generate a continuous flow of negative ions (anions) across a CRT screen to offset the positive ions (cations) created by the high voltage required to illuminate the screen.

Recent studies have shown that persons sitting at video terminals for extended periods of time may be susceptible to cation radiation and experience harmful effects such as eye and skin irritation, fatigue, headaches and respiratory dysfunction.

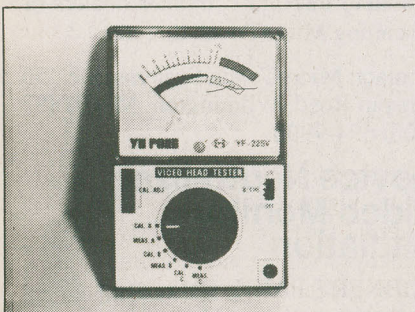
The ELF unit creates a “wall” of anion-enriched air across the face of the screen. The “air wall” first neutralizes the cations in the air around the screen, then continuously replenishes the air within six feet around a video workstation with healthy anionic air. A small amount of ozone in the “wall” oxidizes the possible odours and phenol outgassing of plastic computer enclosures.

The ELF has no moving parts, no propellers, yet generates non-mechanically forced air across the screen and throughout the largest of workstations.

Contact: Jim Aise, Marketing Director, Zenion Industries, Inc., 5430 Commerce Blvd., Rohnert Park, CA 94928 (707) 584-3663.

YF-225 Video Head Tester

KB ELECTRONICS announces the addition of the YF 225 Video Head Tester to its line of electronic test equipment. This economical instrument is used to measure the wear state of the video head. The meter operates on the induc-



tance bridge principle and clearly indicates the declining inductance values as video head wear increases. Models are

available for either the beta or VHS systems, each model featuring three measurement ranges. The unit comes complete with test leads, battery and carrying case and is the fast convenient answer to verifying vtr head wear.

Contact: Jim Peffers, KB Electronics, 1428 Speers Rd., Unit 8, Oakville, Ontario L6J 2P4 (416) 847-8588.

Sams Introduces 3 New Technical Books

CARMEL, IN — Sams, a division of Macmillan Computer Publishing has long been noted for the technical publications it produces. Carving an even deeper niche into the technical publishing market, Sams introduces three new titles.

Electrical Wiring is geared toward trainees, voc-tech students and the do-it-yourself handyman. There's no need for a highly technical background; with *Electrical Wiring*, readers learn practical uses of junction boxes, switches, wire, and electrical connections. Easily understood examples and proven expert advice provide readers with the know-how to design and complete safe electrical connections. (\$19.95, ISBN 0-672-22695-2, 274 pp.)

Necessary reading for anyone who owns or plans to own an IBM Personal Computer, *Interfacing to the IBM Personal Computer* provides information and techniques that can be used in various projects. Touching on many aspects of the PC, this book describes the components of the PC, examines the processor card and its functions, discusses fully the PC bus system, looks at PC memories, and describes its methods of data transfer. (\$16.95, ISBN 0-672-22027-X, 246 pp.)

The *IBM Personal Computer Upgrade Guide* can help make your machine, whether it's new or old, a better one. Readers find the “straight talk” in the *IBM Personal Computer Upgrade Guide* easy to comprehend. Information is offered on selecting hard disk drives and their components, upgrading advantages and disadvantages, completing a computer “makeover,” and printers and their operations. (\$22.95, ISBN 0-672-22723-1, 285 pp.)

Contact: Beth Douglass, publicist, (317) 571-3489

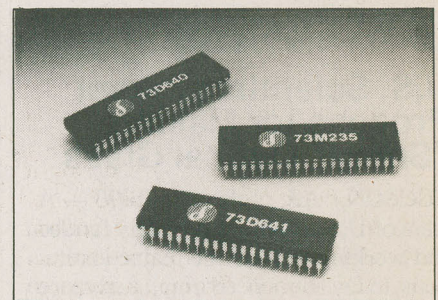
Facsimile Goes Public

AUGUST 15, 1990 — Bell Canada launched a market trial of Public Fax, a new facsimile service designed for the travelling public.

The trial calls for the installation during the month of August of 50 Public Fax terminals — 25 each in Montreal and Toronto — in high traffic locations such as hotels, convention centres, airports and train stations. Similar in concept to telephone booths, Public Fax terminals allow customers to send a fax to or receive a fax from anywhere in the world. To initiate a facsimile transmission via Public Fax, a customer inserts a credit card into the automated card reader slot on the terminal. If sending a fax, the customer then inserts the document to be sent and dials the telephone number of the receiving facsimile machine. If receiving a fax, the customer places a one-minute call to advise the sender of the telephone number of the public Fax terminal and to specify the document to be sent. After the call is completed, the line remains open for five minutes during which time the facsimile transmission must be initiated.

Silicon Systems Dovetails Introduction of PC FAX Chipset with Adoption of Interface Standard

TUSTIN, CALIFORNIA, August 15, 1990 — Silicon Systems enters the FAX/modem arena as the first to offer a PC/FAX device set, the SSI 73D2291/2292, compliant with the newly adopted Electronic Industry Association (EIA) interface standard for PC FAX.



The new standard, designated EIA 578 and adopted on February 6, 1990, provides standardization that guarantees compatibility with third-party

software. This will greatly simplify PC FAX products, both from the standpoint of design and for the end user. Many in the industry liken it to the earlier development of the "AT" command set for conventional data modems which provided a standard for software development that dramatically expanded the acceptance of modem products.

The SSI 73D2292 is intended for applications that require half-duplex 9600 bit/s operation. It provides full Group 3 facsimile modes (V.21 Ch. 2, V.27ter, and V.29), along with the conventional 2400 bit/s data communications. An EIA 578-compatible AT command interpreter with special commands for control of both datacom and FAX functions is also included.

Contact: Dori Braun, Director, Modulations Products, Silicon Systems, 14351 Myford Rd., Tustin, CA 92680 (714) 731-7110.

IBM's New "Crystal Parfait" Promises Electronics, Computer Applications

PLYMOUTH, N.H. July 9 — Demonstrating a bit of chemical magic, IBM researchers today revealed a greatly improved method of growing thin crystal layers of germanium on silicon. The development makes more practical the production of silicon-germanium crystal alloys, materials with great promise in electronics and computers. The researchers discussed their work, the first successful demonstration of this new technique of crystal growth, at the Gordon Research Conference meeting here today.

In developing their new technique, the IBM scientists solved a long-standing problem in growing germanium on silicon: when the germanium crystal grows to more than three atoms thick, it tends to clump or ball up, rendering it useless for electronics applications.

"You need a continuous, uniform layer of germanium," explained project leader Dr. Rudolf Tromp, a research staff member at the Thomas J. Watson Research Center in Yorktown Heights, N.Y. "When the germanium atoms form little balls, you can't grow a smooth crystal."

The scientists have discovered a way to coax the germanium to lie flat on the silicon by creating a kind of crystal parfait. They start with a thin layer of silicon. Then, before growing the germanium on top, they first add a single atomic layer of the element antimony. The antimony rises to the surface — like a layer in a parfait — and forces the layer of germanium to grow flat underneath it.

The scientists call their new method of crystal growth "surfactant-mediated epitaxy." The antimony acts as a surfactant, an agent that changes the surface properties of the silicon (making it chemically more stable), so that the germanium can grow on top of the silicon more smoothly. Epitaxy is the growth of one crystalline layer on top of another. The researchers grow the germanium-silicon crystals using molecular beam epitaxy. The scientists have successfully grown flat layers of germanium 10 atoms thick on silicon, with a perfect match between the crystal structure of the germanium and the silicon.

Contact: Linda Currey Post, IBM, Research Division, P.O. Box 218, Route 134 and Taconic Parkway, Yorktown Heights, New York 10598 (914) 945-2885.

PC Primer — PC Troubleshooting for Everyday Users

PC Primer is an easy to understand primer and troubleshooting manual for IBM and similar personal computers. It is written for the non-technical user and less than a hundred pages long, taking the intimidation and mystery out of understanding and fixing your own computer. Personal computers from the early eighties with 8088 or 8086 processors (PCs and XT's) up to the present 80486-based models are covered.

The focus is on "component swapping." After an explanation of the PC's major parts ("PC Anatomy"), like boards, drives, chips, etc., this booklet shows you how to open a PC and how to find and replace defective parts.

Included is a guide to finding and resolving the twelve most common PC ailments, compiled from the records of Data Support Corporation, a PC service and repair shop in San Leandro, CA.

There is also an explanation of commonly used but frequently unfamiliar acronyms, such as VGA, DRAM, SIMM, and ESDI ("PC Alphabet-soup").

Separate chapters are devoted to personal computer routine maintenance and hard drive problem resolution. If you want to save money on PC repairs, or if you just want to understand the workings of that mysterious box on your desk, *PC Primer* is well worth its modest \$9.95 price tag.

To order call for *PC Primer*, by Alfred G. Weiland, (415) 638-1206 or send \$9.95 plus \$2.00 shipping and handling to: Data Support Corp., 627 McCormick Str., San Leandro, CA. 94577.

Computerized Automobile Convoys Will Save Lives But Cost \$Billions

NEW CANAAN, CT — Gingerly, but with increasing confidence, automobile and highway engineers are moving towards implementation of the "Intelligent Highway." According to a recent industry newsletter article, several billion dollars are likely to be spent by the U.S. alone before the end of the century on so-called Intelligent Vehicle Highway Systems (IVHS), which may eventually permit automobiles to steer themselves in 100 mph bumper-to-bumper "convoys" on interstate highways. The article appeared in *Geographic Information, Mapping and Positioning* (G-MAP) newsletter, published by International Resource Development Inc., New Canaan, CT. The article reviewed prototype developments and research projects, in the U.S., Japan and Western Europe, which are intended to lead to safer, faster travel with less congestion on the world's highways.

In the U.S., says the article, work by automobile manufacturers and the Highway Traffic Safety Administration is proceeding along two general paths, exploring internal and external IVHS. Internal systems are entirely self-contained within the automobile, using inertial guidance or relying upon radio signals from Loran C stations or Global Positioning System (GPS) satellites. External systems use various combinations of beacons, computer networks, buried copper strips and sensor inter-

rogator devices which are placed along or around highways.

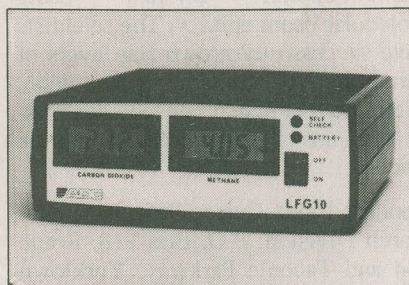
As stated in the article, one of the driving forces behind some of the current IVHS ideas is to save drivers' time by helping them to avoid traffic congestion. Some of the more far-reaching IVHS proposals include such concepts as laying inductive strips to guide computer-coordinated convoys. As a vehicle approaches the highway, a gap would occur in the convoy allowing the vehicle to slip into place. Once the vehicle was in place, the convoy would close the gap, maintaining a constant space between vehicles, a "buffer-zone" of sorts. Speed, of course, would be controlled by the computer and would take into consideration road and weather conditions. According to Kenneth G. Bosomworth, *G-MAP* editor, "One of the big payoffs from IVHS occurs in the decrease of new highways being built." An IVHS system would conceivably allow two to three times the current number of vehicles on a highway at one time; the vehicles would be travelling very close together (while still maintaining their safety buffer-zone), at relatively high speeds. Traffic congestion due to "Sunday drivers" or "rubber-neckers," would not occur, and people would arrive at their destinations quickly and without hassle.

The lack of traffic tie-ups would make the existing highways (especially in metropolitan areas) more than adequate, curbing the need to build new highways and widen existing roads. "This savings alone could amount to billions of dollars over the next twenty years," says Bosomworth. He cautioned, however, that such capabilities aren't likely to be in place until after the year 2000.

Contact: Dia Cheney, International Resource Development Inc., P.O. Box 1716, New Canaan, CT 06840

Monitor for Gas Emissions from Landfill Sites

The potentially hazardous emission of methane and carbon dioxide from

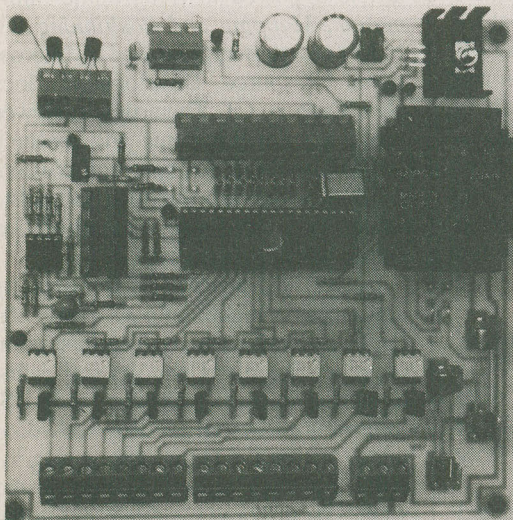


landfill sites can be monitored using a portable instrument from Britain.

The LFG10, from The Analytical Development Company, uses nondispersive infrared absorption to monitor the concentration of the two gases in air. Methane and carbon dioxide are the main gaseous products of the bacterial breakdown of organic matter in landfill sites. Methane is explosive if its concentration in air is in the range of 5-15% and has been the cause of tragic explosions in the past. Carbon dioxide can present health hazards if its concentration in air exceeds 0.5%.

An internal pump in the LFG10 draws the air being analyzed into the instrument via a stainless-steel handheld probe. Separate three-digit liquid-crystal displays indicate the concentrations of both gases and switch automatically between 0-10% and 0-100% ranges, as appropriate. The readings are consistently accurate and not affected by other gases sometimes found at landfill sites. The LFG10 has a warm-up time of less than 60 seconds and a response time of less than 20 seconds.

Contact: Mr. Frank Britton, Nortech Control Equipment Inc., 135 The West Mall, Unit 4, Etobicoke, Ontario M9C 1C2 (416) 622-7820. □



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This book is intended as a follow-up to BP239, and also should be of value to anyone who already understands the basics of voltage testing and simple component testing.

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BP 248: TEST EQUIPMENT CONSTRUCTION \$11.80
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BP 251: COMPUTER HOBBYISTS HANDBOOK \$23.80
This book provides a range of useful reference material in a single source so that it can be quickly and easily located. The subjects covered include microprocessors and their register sets; interfacing serial, parallel, monitor, games and MIDI ports; numbering systems; MIDI codes; operating systems and computer graphics.

BP 247: MORE ADVANCED MIDI PROJECTS \$11.80
This book includes circuits for a MIDI indicator, THRU box, merge unit, code generator, pedal, programmer, channeliser and analyser.

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Find equivalents and cross-references for both popular and unusual integrated circuits. Shows details of functions, manufacturer, country of origin, pinouts, etc... includes National, Motorola, Fairchild, Harris, Intersil, Philips, ADC, AMD, SGS, Teledyne, and many others.

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E.A. Parr, B.Sc., C. Eng., M.I.E.E.

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R.A. Penfold

Projects, fifteen in all, which use a 12V supply are the basis of this book. Included are projects on Windscreen Wiper Control, Courtesy Light Delay, Battery Monitor, Cassette Power Supply, Lights Timer, Vehicle Immobiliser, Gas and Smoke Alarm, and more.

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R.A. Penfold

70 plus circuits based on modern components aimed at those with some experience.

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Although information on stand circuits blocks is available, there is less information on combining these circuit parts together. This title does just that. Practical examples are used and each is analysed to show what each does and how to apply this to other designs.

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R.A. Penfold

A "Solderless Breadboard" is simply a special board on which electronic circuits can be built and tested. The components used are just plugged in and unplugged as desired. The 30 projects in this book have been designed to be built on a "Verobloc" breadboard. Wherever possible the components used are common to several projects, hence with only a modest number of components it is possible to build, in turn, every project shown.

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BP118: PRACTICAL ELECTRONIC BUILDING BLOCKS — BOOK 2 \$7.80

R.A. Penfold

This sequel to BP117 is written to help the reader create and experiment with his own circuits by combining standard type circuit building blocks. Circuits concerned with generating signals were covered in Book 1, this one deals with processing signals.

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Basic Electricity

#6

Ron C. Johnson

I said last month we were going to talk about magnetics this time. And possibly you are all wondering why would we want to know about it for basic electricity. As my students often tell me, they wonder even more after they have wallowed around in this stuff for a while. It's true: magnetism and electromagnetism is a "cat's breakfast" of new terms, formulae and relationships (most of them non-linear) which can be confusing. On the other hand, an understanding of this area is not only useful, but necessary to make sense out of stuff like: inductors, relays, motors, tape recorders... The list goes on.

So we are going to take a run at it on a non-mathematical basis. And if the new terms start to come at you too fast and furious just kick back and imagine yourself listening to one of those foreign language instructional tapes with surf in the background. If it puts you to sleep I want to know.

Maybe I'll market it...

THE MAGNETIC FIELD

To start with we are not going to try to explain what magnetism is in its most fundamental form. Call it one of those mysteries of the universe that only Phd's and people confined to institutions truly understand. For our purposes we want to know the *how* more than the *why*.

All of us are familiar with those strange new life-forms which appear out of nowhere and then multiply on the doors of our refrigerators. Yes, the fridge magnet beings have insinuated themselves into the very fabric of our homes, attaching themselves to our appliances under the guise of grocery list holders, real estate advertisements and kindergarten crafts...What? Ah, yes... the magnetic field. Back to business.

As I said, we are all familiar with magnetism from its various household uses and no doubt we have all played with magnets enough to have a first-hand knowledge of how they are attracted to objects with iron in them. We have also seen how bringing two magnets together will cause either attraction or repulsion depending on how they are

the ends, or poles, of the magnet are labelled North and South is that if the magnet were suspended freely the end labelled N would orient itself toward the magnetic North Pole of the earth (like a compass). The same force that causes this is the force that causes the attraction or repulsion between two magnets. When a North and a South pole are brought together they attract; when two North's or two South's are brought together they repel.

Yes, I know that this is nothing new to most of you but the basics bear repeating before we launch into the other good stuff. And there really is an application here: The magnets we are used to seeing are natural or synthetic magnets which are relatively weak. Also, we don't have much control over them other than moving them physically closer or farther away from an object. But if we could control those lines of flux (and the magnetic force that they produce) with electricity, we would be able to build a number of useful things such as: meter movements, relays, breakers, solenoids, motors, etc. (Love that word, "etc." It covers a whole range of things I can't remember.)

Okay, let's look at Electromagnetism. First a history lesson: In 1820, the Danish physicist Hans Christian Oersted discovered (history always starts out the same way, doesn't it?) that the needle of a compass would deflect if brought near a current-carrying conductor. This proved that electricity and magnetism are related. Actually, what

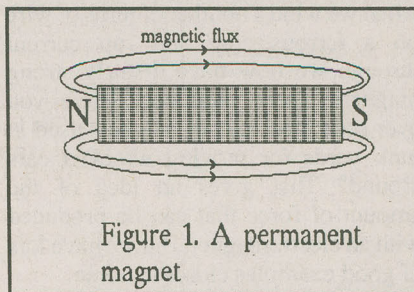
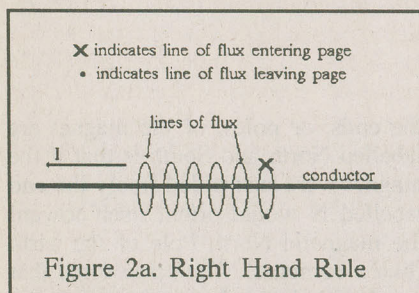


Figure 1. A permanent magnet

oriented with respect of each other. Figure 1 shows a bar magnet with a set of lines (with arrows) extending out of one end and re-entering the other end. These lines are called lines of flux. You will notice that the lines of flux exit the end labelled N (for North) and re-enter the end labelled S (for South). The reason

Hans proved was that a magnetic field always occurs in conjunction with current flow. The magnetic flux (same as the lines around a magnet) form concentric rings around the conductor and we can predict the direction of the lines (remember the arrows on the bar magnet lines of flux) by using the "good ol' basic" Right Hand Rule.

The Right Hand Rule is simple. If you were to imagine yourself holding a current carrying conductor in your right hand with your thumb pointing in the direction of conventional current flow (opposite of electron flow, remember), the rest of your fingers point in the direction of the lines of flux as they



curve around the conductor. (See Figure 2a)

So that means that any conductor with current flowing through it will produce a magnetic field.

Is that important?

Actually, the strength of the field is small in most cases but there is a way of putting that field to use and making it more powerful. Take a look at Figure 2b. At this point we have to start imagining what is happening in three dimensions. Let's use the convention that an 'x' indicates a line of flux entering the page from above. A dot, '.', indicates a line of flux exiting the page.

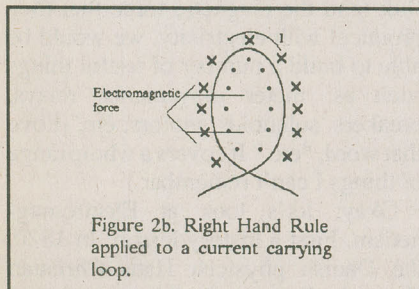


Figure 2b shows a loop of wire with current flowing through it. If we use the Right Hand Rule to determine the direction of the lines of flux and try to visualize it in three dimensions we will find

that the lines from one side of the loop point in the same direction as the lines from the other side of the loop. This causes the lines of flux to be concentrated in the middle of the loop. If we were to add several more loops all the lines would reinforce each other increasing the strength of the magnetic field.

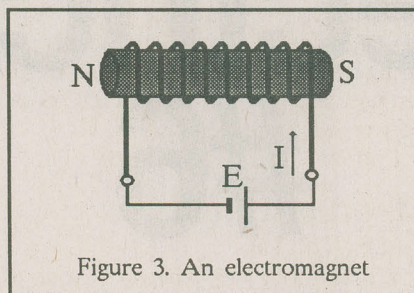


Figure 3. An electromagnet

That's what we have done in Figure 3. Not only have we used several turns of current carrying wire (supplied by the battery), but we have added a "core". The core is a ferrous material which concentrates the lines of flux. This increases what we call the "flux density" because there are more lines of flux in a smaller space. Up to a certain point increasing the flux density increases the "field strength" of the electromagnet, in other words making it a stronger magnet.

Some Applications

Before we get into the nitty-gritty of all this let's look at what it means in practical terms. As I said before, a single conductor with current flowing through it creates a magnetic field around it doesn't accomplish much for us. But when we wind a number of turns of wire on a ferrous core and run current through we now have a fairly strong magnetic force produced. Have you ever seen those electromagnets used in junk yards for moving wrecked cars around? That gives an idea of the amount of force that can be produced with an electromagnet. But we have lots of good examples closer to home.

Electric door latches used for security locks in apartment buildings are electromagnets. Normally a spring latching mechanism keeps the latch locked but when the button is pushed in the apartment current flows through the coil of an electromagnet in the latch pulling back a metal bolt which allows the door to be opened. For those of you

who have experimented with relays the application is similar: The electromagnet, when energized, pulls in a metal linkage that forces the contacts together (or apart in some cases) positioning the relay contacts in the energized condition. (When you hear the term "normal" as in "normally open contacts" or "normally closed contacts" this means that the relay coil is not energized and the contacts are either open or closed when the relay is at rest.)

Another application for electromagnets is solenoid valves. They are used in common household appliances like your dishwasher to control the water. A valve is controlled by an electromagnet moving a ferrous plunger in or out. Reluctance is symbolized by R and is usually expressed in "per Henrys". (In other words the reciprocal of Henrys)

Keep in mind that I warned you! And it gets worse. Take a deep breath...

So permeance and reluctance are reciprocals. Believe it or not, so are permeability and reluctivity, but don't worry, we don't use these much. If you are interested, reluctivity is the magnetic equivalent to resistivity (in electricity) that we talked about way back when in the first article of this series. Resistivity, we said, was the characteristic of a material that determined how well it conducted electricity, and hence, determined the resistance of a particular shape and size of the material. Well, reluctivity is the characteristic of a material which determines how well it sets up lines of flux and hence, the reluctance or a given piece of that material. In this case we most often use permeability, the reciprocal of reluctivity, which is symbolized, μ , and has the units, Henry/metre.

Now that we have looked at flux and reluctance we can backtrack and look at how they relate to magnetomotive force. We know about Ohm's Law from electricity; here is its equivalent in magnetism: Ampere's Circuital Law.

Ampere's Circuital Law says that magnetomotive force equals the magnetic flux, $(-)$, times the reluctance of the material, (R) or:

$$F = - \times R$$

This operates in the same way as Ohm's Law. For various materials a magnetic field reluctance is symbolized

by R and is usually expressed in "per Henrys". (In other words the reciprocal of Henrys)

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Ampere's Circuital Law says that magnetomotive force equals the magnetic flux, (Φ), times the reluctance of the material, (R) or:

$$F = \Phi \cdot R$$

This operates in the same way as Ohm's Law. For various materials in a magnetic circuit (which have different reluctances), the amount of flux present in that section times the reluctance will give the magnetomotive force developed across that section. The same relationships we talked about with respect to Kirchhoff's Voltage Law around a loop apply around a magnetic loop and series and parallel principles apply in the same way. (Figure 4).

Not that it matters...

Actually, you won't find hobbyists, technicians, technologists or even very many engineers use this stuff quantitatively in practical applications. Designing transformers or other special magnetic equipment would require it, but usually we just buy that kind of thing with ready-made specifications avail-

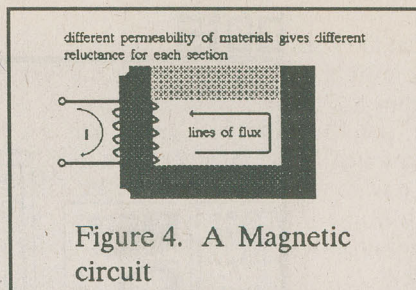


Figure 4. A Magnetic circuit

able. Even so, the concepts are interesting and help to understand what is going on. In fact, as we continue, we'll see how they help us understand some very practical applications.

Coffee's over. Back to work.

Magnetic Field Strength

We all know that when we move a magnet closer to a ferrous object the pull is greater than when it is farther away. How strong the force of that "pull" is can be expressed as magnetic field strength (or intensity) and is symbolized, H, with units, Oersteds. (Well, they had to name *something* after the guy.) It is determined by the magnetomotive force, (F) divided by the distance, (l).

$$H = F/l$$

Another important variable in magnetism is called magnetic field density or flux density, (B), given in Teslas. (Some other guy who, incidentally, also liked to play with high voltage.) Basically, flux density is the number of magnetic lines of force per unit area, (A). (If you go back and sort through some of the previous stuff, you would find that the number of lines of flux is determined by the magnetomotive force and the reluctance of the material.) So the formula is:

$$B = \Phi/A$$

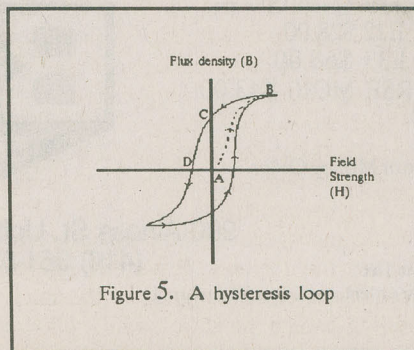


Figure 5. A hysteresis loop

Okay! Believe it or not, we're going to tie this all together now.

Figure 5 shows a graph called a Hysteresis Loop where the vertical axis is labelled B for flux density and the horizontal axis is labelled H for field strength. An interesting thing happens when you use an electromagnet to magnetize a ferromagnetic material: To begin with, before any current flows through the coil, there is no magnetic field strength present and so no flux density (Point A). As current is applied field strength is created by the electromagnetic field set up and this causes a certain flux density to be present in the ferromagnetic material (this material could be the core of the electromagnet or adjacent but within the field). As the field strength (H) is increased eventually the flux density levels off and even though H is increased B will stay the same. (Point B) This is called flux saturation.

Now let's start to reduce the current through the coil (and hence the field intensity). The arrows in Figure 5 show that the flux density does not follow the same path back to zero. In fact, when the field strength is zero B is still quite high. (Point C). Why would this be?

Of course, you have magnetized the material and even though there is no electromagnetic force acting on it, it still retains some flux at the density shown. If we were to reverse the polarity of the current through the coil and force the field intensity to be set up in the opposite direction eventually we could bring the flux density down to zero. (Point D). Continuing on, we could eventually reach a saturated point in the other direction.

What's it all about?

We've just invented core memory! We'll be rich! All we have to do is...

That's what core memory was about: thousands of tiny ferrous toroids with coils through them which would magnetize them in one direction when a pulse of current was supplied. After the power was removed they retained their magnetism. Non-volatile memory. (As long as nobody got silly with a magnet in the vicinity.)

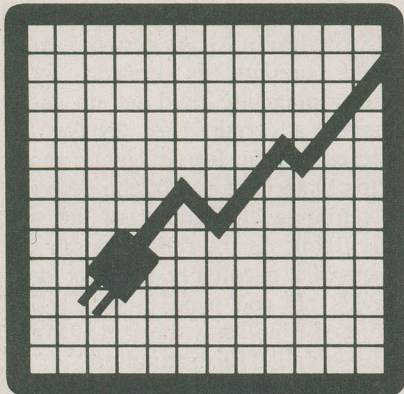
And that's magnetism. Sort of. It actually gets pretty complex when we look at how electromagnetism is used to create electric motors because not only

do we have to consider three dimensional vectors but alternating voltages, currents and phase angles come into it as well.

Maybe we'll look at it in another article.

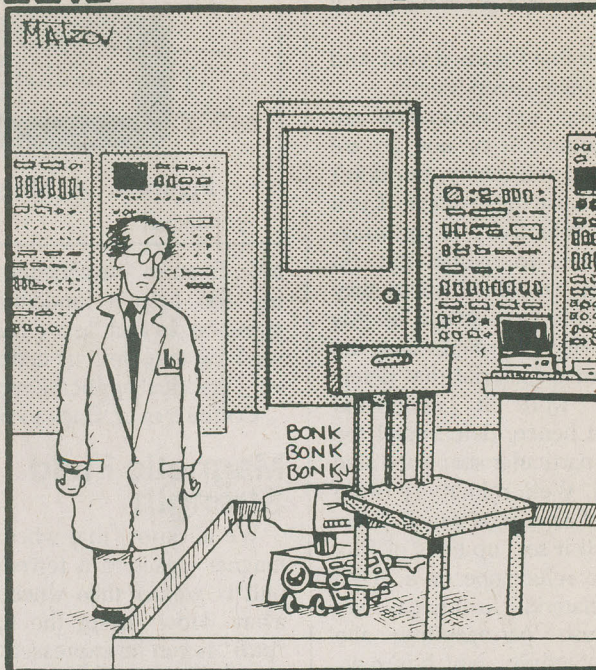
Meanwhile, hopefully this will help you understand the basic concepts without losing you in the jungle of terms. Next time we look at inductors...

□



bots

by Ron Matzov



Although equipped with the X-700 microprocessor unit and 500 megabytes RAM, the robot still could not understand the concept of going around furniture.

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Basic Electricity

#7

Ron C. Johnson

Hello, again, and welcome to that game show that has something for everyone! Yes, you guessed it folks, Basic Electricity: Name that Theory. Please welcome my lovely assistant and technician extraordinaire.... Here she comes, folks, Suzy Psi... Thank you very much! My name is Newton Force and I'll be your host today... Thank you, thank you. And now for our first two contestants... Let's hear it for Michael Faraday and Heinrich Lenz.....

Remember the last segment and the good ol' Right Hand Rule? Well, we haven't heard the last of it. This time we'll be continuing with some of the principles we learned in electromagnetics and go on to RLC circuits. We talked about some of the physics and math concerned with producing a magnetic field from an electric current and how the magnetic field behaves in a magnetic circuit. To start, we'll check out the inductor, its principle of operation, physical construction and applications.

The inductor is one of the three main passive electronic components. Way back when, we learned about resistance, how it is based on the conductive properties and geometry of a material.

Later, we talked about capacitors, which are based on the principle of electrostatics: charges and their electric fields. The third, as mentioned, is inductors which operate using the principles of electromagnetism and its application.

Faraday's Law of Electromagnetic Induction

The Right Hand Rule we talked about last time stated that if conventional current flow in a conductor flowed the direction of your right thumb the rest of your fingers would point in the direction of the magnetic lines of flux present around the wire. We used that to show how winding the conductor around a core produced a higher level of magnetic flux, because all the lines pointed the same way through the core. Now we'll consider the Right Hand Rule again in a slightly different perspective.

If you have a permanent magnetic field with a conductor which is physically moving through it, you will produce a current in that conductor. (That's not a new development. Michael Faraday proved that way back when, even before the first MASH rerun. 1831 to be exact). The Right Hand Rule says that, with your hand oriented with the palm up and index finger ex-

tended, if your thumb points in the direction of motion of the conductor, your index finger indicates the direction of conventional current flow and the other fingers (curved around) indicate the direction of lines of flux present.

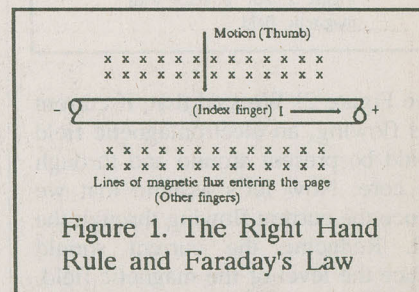


Figure 1. The Right Hand Rule and Faraday's Law

Sounds weird, but try it while looking at Figure 1 and it works. (As in the last article the X's indicate lines of magnetic flux which are entering the page. This convention allows us to visualize in three dimensions.)

But what does it mean?

One application, to start with, is generator action. If we build a mechanism with a strong fixed magnet and then spin a coil of wire in the electric field we will produce current. That's what happens, in its most fundamental sense, in the generator or alternator in your car. And there are other applications, like inductors, but we have to check out Lenz's Law to see how they operate.

Lenz' Law

If moving the conductor through the lines of flux of a magnetic field creates current, how about keeping the conductor fixed and moving the magnetic field? Okay, would we actually have to move the field physically, or could we just change its intensity? You got it. The induced current is directly proportional to the rate of change of the magnetic field so all we have to do is change its intensity.

Now let's look again at the coil we talked about last time where we wrapped the conductor around some kind of core (usually ferrous material).

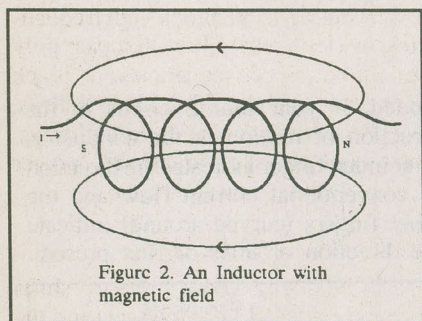


Figure 2. An Inductor with magnetic field

(See Figure 2) We said that, if current was flowing, an electromagnetic field would be present around and through the core. Now let's assume that we reduce the current flowing through the coil. Reducing the current should reduce the level of the magnetic field. According to Faraday's Law, that change in the magnetic field should induce a current into the coil. Sometimes we think of this in terms of a voltage, and actually, because it opposes the change, we call it counter emf (electromotive force). So it happens that, because the magnetic field is collapsing, the direction of the change in the magnetic field produces a counter emf which induces a current in the same direction as the original current flow. This tends to keep the current flowing at the original rate even though we have attempted to reduce it. Of course, we aren't getting something for nothing; the energy which had been stored in the form of the electromagnetic field is just being converted back to electrical energy (generator action). The current changes with time towards the new level and the field eventually stabilizes as the current settles out at the lower rate.

The important thing is that this takes time. Thinking back to capacitors, you might remember that the voltage across a capacitor cannot change instantaneously; it takes time for it to charge up to the final voltage. Inductors are the same, only different; the current through an inductor cannot change instantaneously. It takes time for the magnetic field to stabilize as it either stores or releases energy to or from the magnetic field. Take a look at Figure 3 and you'll see a graph that is similar to the charge curve of a capacitor. In the case of an inductor, the exponential curve

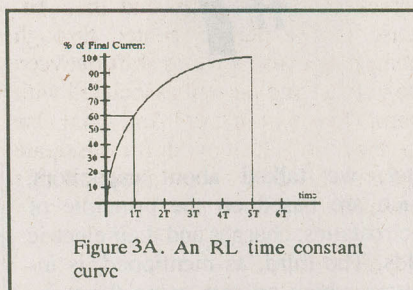


Figure 3A. An RL time constant curve

represents the current changing with time. Figure 3A shows the curve for

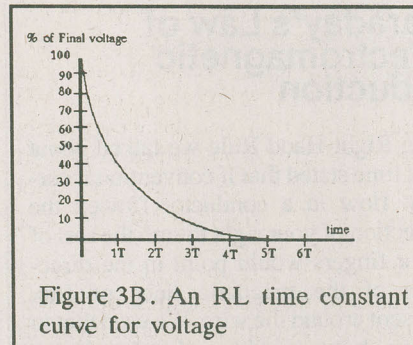


Figure 3B. An RL time constant curve for voltage

increasing current while Figure 3B shows the curve for decreasing current.

The Component

So this ability of a component to oppose a change in current is called self-inductance, or more commonly, just inductance and the component which achieves this is an inductor. Inductors are coils of wire wound on ferrous cores and come in a wide range of sizes, both physical and in terms of their specifications. The formula symbol for inductance is L , and the unit symbol is H , for Henry. Inductors usually come in values ranging from a few microHenrys to several Henrys.

The value of the inductor is determined by the number of turns on the

core, the cross-sectional area of the core, the permeability of the core material and the length of the core.

Well, there you have it: a quick look at inductance from the point of view of DC and its transient characteristics. We're going to backtrack a little, now, and try to pull together several topics we've talked about in this series. So I hope all you contestants at home are ready on your buzzers 'cause for 20,000 points and a chance at the bonus round....

How do capacitors and inductors operate with respect of alternating voltages and currents?

I hope you have been following this series since the beginning because back in segment four we introduced the area of alternating voltage and current, what it looks like, its characteristics and the concept of phase differences. This is very important when we talk about inductance and capacitance. In addition, there are a few new terms and concepts we'll talk about here.

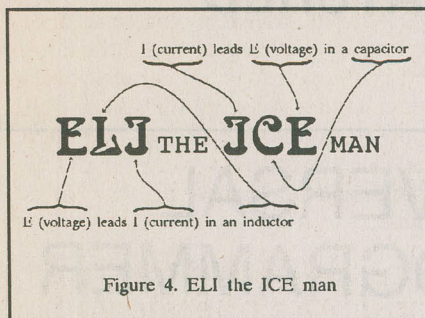
Let me start by asking a question: From what we know so far do inductors and capacitors dissipate power ($I \times V$) in the same way that resistors do? The answer is no. We have learned that capacitors and inductors only store energy "in an electrostatic field and electromagnetic field respectively. When required, that energy can be sourced back out of the component and used. (It is true that both these devices have some resistive component to them and as such do have some power loss, but it is insignificant for this consideration.)

Eli The Ice Man

Next, let's consider the action of these devices in an AC circuit. We know that the voltage across a capacitor will not change instantaneously. What about the current through it? With DC when you try to change the voltage across a capacitor, current flows immediately into the cap charging it up at the rate of the current. So we can say the in a capacitor the current leads (changes before) the voltage, or, I leads E in a capacitor.

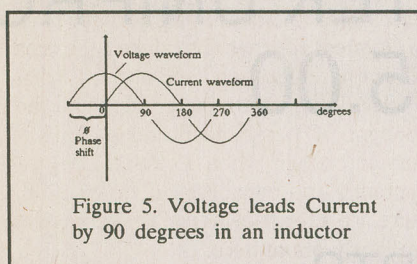
We also know that the current through an inductor cannot change in-

stantaneously. This means that the voltage may change before the current, or, E leads I in an inductor. We remember these by the simple mnemonic: ELI the

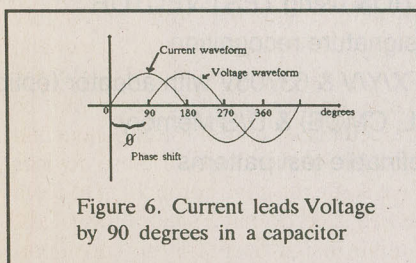


ICE man. (See Figure 4.)

Figures 5 and 6 show the phase relationships between the voltage and

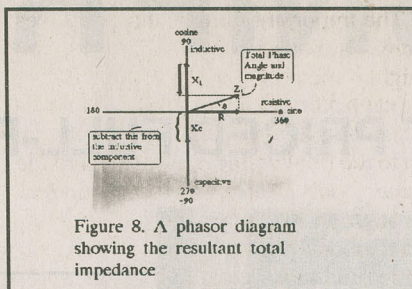


current in inductors and capacitors respectively. The amount of phase shift through the device is always 90° but, using the current waveform as the refer-



ence (starting at zero), the inductor's voltage crosses at 90° before the reference whereas the capacitor voltage crosses at 90° after the reference. When the phase shift is to the left of the reference (leading) we give it a positive value, ($+90^\circ$). When the phase shift is to the right, (lagging), we give it a negative value, (-90°).

We can also show these relationships on a phasor diagram, (Figure 8), and we'll be looking at this a little more, shortly. For now, just note that the zero axis for the diagram is the one marked sine. This is the reference. Ninety degrees counter-clockwise we have the cosine or inductive axis, where we can



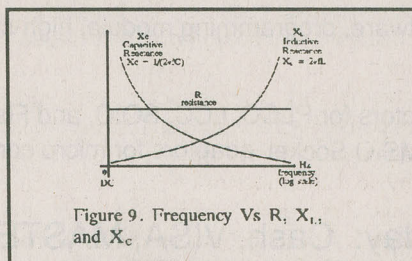
display the inductive component. Ninety degrees clockwise from the reference is the capacitive axis. This is also labelled -90° .

So now we know that inductors and capacitors store energy and that, because of the delays created through them, they cause a phase shift between the voltage and current associated with them. Does that matter? And what else do they do? If they don't dissipate power, why do we care about all this phase shift stuff?

Reactance

Okay. Even though they do not dissipate power, both inductors and capacitors do affect the current flow of the circuit they are in. Moreover, in AC circuits, they affect the current flow differently depending on the frequency of the AC supply voltage or current. We said that these components were mainly used for timing applications in DC. In AC we make use of the fact that capacitors and inductors are frequency dependant components.

We know that resistors have the same value of resistance regardless of the frequency of the current through them. In the case of capacitors and inductors we use the term reactance. Reactance is the property which opposes the flow of AC current through capacitors or inductors. It is similar to resistance in that it is measured in ohms but it is dependant



on frequency. Figure 9 shows a graph of resistance, capacitive reactance and inductive reactance versus frequency. It also gives the formulae used to deter-

mine the values of X_C and X_L . It is important to note that while the relationship between frequency and reactance is a linear one, it appears non-linear on the graph because we normally use logarithmic scales to show frequency in order to condense the range. (There are other reasons, as well, but I'll have mercy.) So capacitive reactance starts at a very high value at low frequencies and decreases as frequency increases. Inductive reactance is the opposite: low at DC and high at high frequencies.

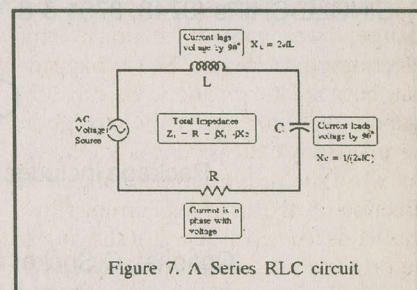
What is the application? By the judicious use of combinations of caps and inductors we can build circuits that are frequency dependant: filters that pass low frequencies but block high frequencies, or vice versa; filters that pass only certain bands of frequencies, or block only certain bands... This list is endless. We use them in TV and radio circuits, tone controls and equalizers, power supply filters, noise filters, etc.

The RLC Circuit

We've talked about phase shifts through individual components and the reactances and resistances of individual devices. Now, we'll try to pull some of this together to finish things off.

If the phase shift across an inductor is $+90^\circ$ and it has some value of reactance, and you put this in series with a capacitor, with a -90° phase shift and some reactance, what is the result? And what happens if we add a resistor in series as well? And what if we change the frequency of the AC power supply?

Figure 7 shows a circuit like that: a

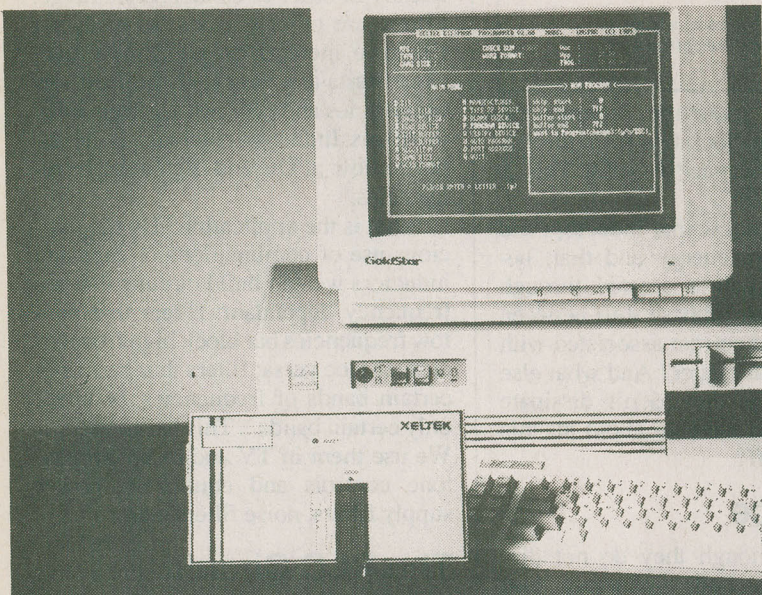


series RLC circuit. We would like to be able to determine the AC current in this circuit (given an AC supply voltage), but how? If all the components were resistors we would just add them up and use Ohm's Law. In this case it becomes quite a bit more complicated. Instead of total resistance, we have to use total

See Basic, Cont'd. on page 34

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C Programming for Techies

This month we'll look at the rational and a bit of the thought processes in translating a procedure into a C program... as well as a rather interesting bit of code.

Steve Rimmer

Programming is an art form, and like all art forms it must be approached with a certain amount of discipline, lest it become chaotic. Art only looks undisciplined to people who don't understand it.

The process of translating an idea into a working program is to a large extent intuition wrapped around a core of programming expertise and some rules which can be applied to programming projects in general. While you may never have to consider the creation of a program with quite this degree of abstract philosophy, the philosophy remains none the less.

It's all very zen-like.

This month we're going to take a rule and a desired function and walk through the steps involved in creating a program to make it all happen. Some are purely programming steps, but many are decisions based on an intuitive understanding of how programs should work and how users will apply them.

Visa Madness

This month's program is a small utility which will ascertain whether a credit card number is, in fact, valid. It's based on a somewhat unknown property of

credit card numbers, that is, that they are self checking. The first digit of a credit card number tells one what kind of credit card the number belongs to. The last digit is a checksum. The intervening digits, which are unique to each individual card, can be run through a calculation which will spit out the checksum if all is well.

You might want to scrape the pocket lint off your plastic and see if all this makes sense to your cards.

The easiest thing to check by eye is the card type digit, the first one. This will be five for a MasterCard, four for a Visa card and three for an American Express card.

Credit card numbers are based on the concept of a checksum, something you might not have encountered before. In its simplest incarnation, a checksum is a value which is derived by adding together all the bytes in a block of data. If you store the data and store the checksum separately, you can subsequently make sure that the data hasn't been mangled by adding up the bytes again and seeing if the result still equals the checksum.

Obviously a checksum is not infallible. If one byte were to be decremented by one and another byte incremented by one, the checksum value would remain unchanged even though the data did not. However, for practical purposes a checksum provides a moderate level of data integrity with a tiny penalty in computer time. Checksums are quick and easy to calculate.

A checksum rarely consists of a true sum of the data it checks. Most checksums have an inherent modulus value imposed by the size of the object used to hold the checksum. For example, if

you add all the bytes in a text file together and use a *char* to hold the running checksum, you will get a unique eight bit value with 256 possible states. All the bits beyond eight will be thrown away. This is a pretty decent checksum for most purposes.

The checksum used by credit card numbers is handled with a modulus of ten, as credit card digits can only have values from zero through nine.

The formula for working out a credit card checksum is a bit complex, presumably to make it difficult to fake in one's head. Each digit in the string has a position number, zero being the first, one the next one and so on. Digit zero is the card type digit, but it's included in the checksum calculation. The last digit in the string is the checksum, and is not.

The calculation is different depending on whether the length of the string is odd or even.

If the string length is odd, start with the last digit to be checked in the string and count backwards through the string. For each digit, if the position of the digit in the string is odd multiply the value of the digit by two and add it to the running checksum. Otherwise, just add it to the checksum as it is. The checksum will always be worked to modulo ten.

If the string length is even, the even numbered string position values are multiplied by two.

Practical Plastic

The intent, in writing a credit card checking program, should be to make it practical to use in applications where credit cards turn up a lot, such as in a store. We'll allow that the computers in most stores are pretty simple... and pret-

ty slow. We'll also allow that fancy graphics, a graphical user interface, complex instructions and so on will probably not go over well in a situation wherein someone must check a lot of numbers in a hurry, probably with someone waiting for their bill.

This is one of those situations in which a command line utility is probably ideal. Actually, a resident, pop-up program might be better still, but it's beyond the scope of this article to discuss how to write one.

I called the program which does this function PLASTIC.C, the resulting executable file from which got renamed to PL.EXE. The idea was to be able to type something like

```
PL 3999-999999-99000
```

and have it come back saying that this was a valid American Express number. In fact, it wouldn't do so in this case because this is *not* a valid number. Make sure you keep those valid plastic numbers you are aware of to yourself.

The credit card number is actually just a string of text, and it's desirable to treat it as such, rather than as a number. However, because the calculation of the checksum is dependant upon the position of the digits in the string, non-digit characters such as the dashes which separate the segments of the number on a credit card can't be allowed to interfere with the works.

You could just insist that the argument to the program be typed with nothing but numbers, but this would make

the result hard to check by eye, especially because it would look different from the number as it's displayed on a credit card. It's better to create an internal version of the argument which has been cleaned up for the calculation.

Cleaning up the string is pretty easy, actually. Simply scan through the source string and copy to a destination string only those characters which are digits. The *isdigit* macro is helpful in this. You can see such a function in the source code accompanying this article.

There is another function which we'll find useful in performing the checksum calculations. Bearing in mind that it's frequently necessary to know whether a number is odd or even, we might do well to create a function that works this out. A number is odd if it can't be divided evenly by two, and if such a number is expressed in binary form, it will be found to have its first bit set no matter what the value of the complete number is. Thus, if the number is *n*, (*n* & 1) will be true if the number is odd.

You can write this into a function,

```
odd(n)
int n;
{
    return (n & 1);
}
```

or you can make the compiler handle the calculation for you each time it occurs by using it as a macro.

```
#define odd(n) (n & 1)
```

In the first case, your code will be minutely slower because your program will actually have to go and call the *odd* function each time it's needed. In the second case it will be faster but minutely larger because the actual code to do the calculation will appear multiple times throughout your program.

In the case of the credit card program the difference doesn't matter, but you should think about the differences between using functions and macros in more involved programming projects when you want to trade off size and speed.

Having done all this preliminary juggling, you can write the actual function to do the calculations pretty simply, as shown in the complete source for PLASTIC.C.

Don't Leave Home Without It

The dreadful temptation in doing little programs like this one is to embellish them into unusability. Add a couple of sound effects, flashing error messages, some graphics and pretty soon no one will use your code.

It's a good rule of thumb to assume that most people don't have colour monitors, don't listen to the sounds their computers make if, in fact, they can actually hear them over the ambient noise and wouldn't know what to do with a mouse short of tying an anchovy to it and taking it home to serve as an ersatz cat toy. □

```
/*
credit card number check program
copyright (c) 1990 Alchemy Mindworks Inc.
derived from a Pascal program by Daniel J.
Karnes
*/

#include "stdio.h"
#include "ctype.h"

#define MASTERCARD '5'
#define VISA       '4'
#define AMEX       '3'

main(argc,argv)
int argc;
char *argv[];
{
```

```
    char b[128];
    int i;

    cprintf("\r\nAlchemy Mindworks "
            "Inc. credit card verification "
            "program version 1.0\r\n");

    if(argc>1) {
        for(i=1;i<argc;++i) {
            cleanString(b,argv[i]);
            cprintf("Card %-30.30s - ",argv[i]);
            verify(b);
            cprintf("\r\n");
        }
    } else cprintf("\r\nI need one or more "
                  "credit card numbers to verify");
}
```

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Cont'd. from previous page

```
verify(s)
char *s;
{
    int i,len,x=0,y=0,v=0;
    if(strlen(s) < 12) v=0;
    else {
        len = strlen(s);
        if(odd(len)) {
            for(i=(len-2);i>=0;-i) {
                if(odd(i)) y=((s[i]-'0')*2);
                else y=(s[i]-'0');
                if(y>=10) y=((y-10)+1);
                x+=y;
            }
        }
        else {
            for(i=(len-2);i>=0;-i) {
                if(odd(i)) y=(s[i]-'0');
                else y=((s[i]-'0')*2);
                if(y>=10) y=((y-10)+1);
                x+=y;
            }
        }
        x=(10-(x%10));
        if(x==10) x=0;
        if(x==(s[strlen(s)-1]-'0')) v=s[0];
        else v=0;
    }
    switch(v) {
        case VISA:
```

```
        printf("verifies as a Visa card.");
        break;
        case MASTERCARD:
            printf("verifies as a MasterCard.");
            break;
        case AMEX:
            printf("verifies as an American Express
card.");
            break;
        default:
            printf("is not a good credit card
number.");
            break;
    }
}

odd(n) /* return true if n is an odd number
*/
int n;
{
    if(n & 0x0001) return(1);
    else return(0);
}

cleanString(dest,source)
char *dest,*source;
{
    while(*source) {
        if(isdigit(*source)) *dest++=*source;
        ++source;
    }
    *dest=0;
}
```

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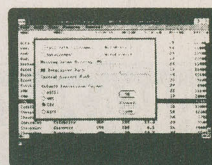
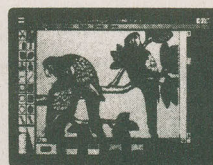
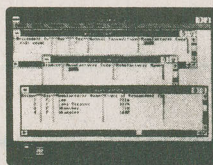
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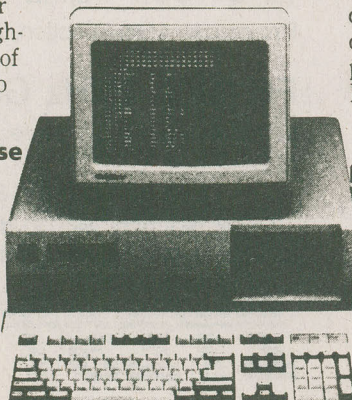
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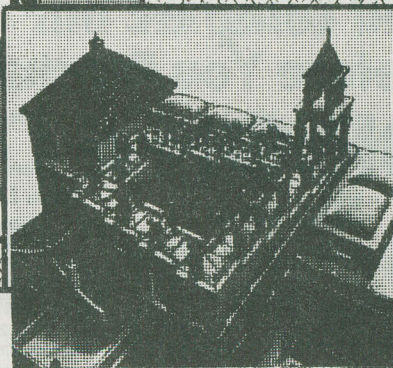
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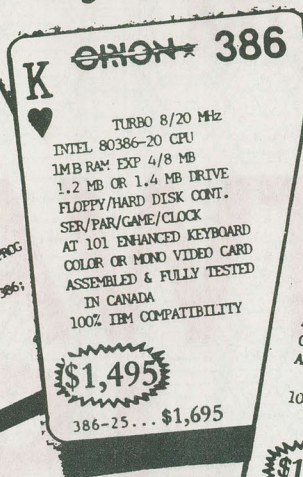
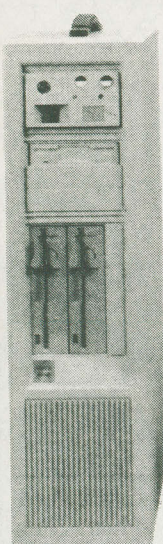
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ALMOST FREE SOFTWARE
VOLUME 64NEW
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CATALOG

MULTIPAD is a Microsoft Windows application which will allow you to open multiple documents at once. Also, unlike the standard notepad, it can deal with files larger than sixty-four kilobytes. Requires Windows 3.

DIRECTORY SORT will permanently sort your disk directories, such that when you use the DOS DIR command everything will appear in alphabetical order.



BLUE DENIM (FRAGMENT) FROM COLOUR CLIP ART 11

FOGFIN is a useful tool for writers and anyone else who wants to be sure their prose is as readable as possible. It will analyse your writing for extraneous statements, convolutions and other characteristics which make it harder to follow.

VFILE dates back to the dark days before the birth of the IBM PC. Newly updated, this venerable DOS shell a fast, easy way to copy, delete, run, rename and otherwise meddle with files, all without a lot of typing. This version requires an 80386 based system to run, but it runs like the wind.

WILLIAM TELL is a small BASIC program which plays the William Tell overture... or, if you prefer, the theme from the Lone Ranger. Requires BASIC.

NG TRIVIA boldly trivializes what no-one has trivialized before. Loaded with questions about episodes of *Star Trek: The Next Generation*, it will test your knowledge of the details and nuances of this popular program.

HOVERCRAFT is a splendid ASCII game which will run on any monitor. The object of the game is to pilot your hovercraft around hostile territory and kill the nasties.

FERN is useless but interesting. It will draw a fern fractal to as many iterations as you care to wait for. The source code in C and BASIC are included so you can see how it works.

JPNFONT is a nice EGA or VGA screen font which will make the text on your screen a bit more interesting to look at.

TETRIS for Windows 3 is a first class implementation of the classic falling block puzzle. If you use Windows for serious applications much of the time, pop this up now and again to keep your brain from seizing up.

ATMOIDS is another Windows 3 application. It plays a mean game of Asteroids, the classic arcade attraction from years gone by.

HOMEOWNER will help you to analyse the cost of home ownership, working in things like the cost of your mortgage, taxes and the like. Considerably more realistic than a simple mortgage table, it will give you a better idea of what you can really afford.

MAZE will create mazes of virtually any complexity and then allow you to solve them.

PHAROAH'S TOMB is the best shareware game to come along since Captain Comic. Using stunning EGA graphics it drops you into the pharaoh's tomb, an exceedingly nasty place with dozens of levels, chambers, monsters and, of course, death in more forms than you can easily count. Pick up treasure, vanquish the bad guys and try to keep breathing. Requires an EGA or VGA card. Also includes a cheat program.

EXTENDED DIR is a handy program which allows you to attach comments to the entries of your directories.

MAXI is the latest version of Maxiform, a brilliant bit of code which will allow you to get 420 kilobytes of data on a standard 360 kilobyte floppy disk, with similar gains on other formats. Stomp that "insufficient disk space" message into the Twilight Zone.

TILE is a handy Windows 3 application to show you what a BMP fragment will look like if you use it as tiled wallpaper.

FLASHBOX is the best memory resident notepad we've come across. At the press of an alternate key it will appear over any application and allow you to jot down or recall important information.

FONTRES solves the problem with loadable EGA screen fonts - that is, that they tend to vanish when you run or exit an application. This little wonder makes 'em permanent until you reboot your machine. Includes many example fonts.

CLICK is a tiny program to add a click to each key of your keyboard. This is a great asset for anyone with a keyboard lacking good tactile feedback.

CROSSWORD is a superb crossword puzzle game. Including twenty-five prewritten crossword puzzles as well as the facility to create your own, it will allow you to cheat to any degree you wish... or even to solve them with no help at all.

BATCH COMPILE The problem with batch files is that they're so slow. This program will generate an executable file based on almost any batch file, shifting the whole works into overdrive. You'll be amazed at how much this improves the performance of your computer if you use a fair number of batch files.

\$24.95 (TWO DISK SET)

ALMOST FREE SOFTWARE
VOLUME 63

DOTS is a thoroughly maddening little game, all the more so because it looks so easy at first. Requires an EGA or VGA card.

NEW
IN THIS
CATALOG

FUNKEY is a quick and easy way to make your functions keys spit out macros. This tiny utility is ideal for setting up one-key DOS commands, tagging Ventura text in your word processor or storing frequently used names or terms.

PRINTER INTERCEPT is a great way to get around problems of printing foreign language characters, special symbols and other applications of printing one thing and seeing another. It traps your printer output and replaces selected characters with anything else you want sent to the printer.

SHORTHAND is a program to improve your typing throughput. It will expand short words or abbreviations into long ones on the fly, allowing you to avoid keying in long, frequently used phrases in their entirety.

VGA FONTS this collection includes three alternate text mode fonts for VGA card users, guaranteed to make your screen more interesting to look at. Requires a VGA card.

MORTCOST is a BASIC program which will help you evaluate the cost of various mortgage options. Requires Microsoft BASIC.

TREE is a powerful DOS shell which will obviate the need for remembering all those cryptic DOS commands, switches and parameters.

FLYSWATTER will leave you reaching for the Raid. A superb EGA graphic arcade game, its object is to swat all the flies before they surround you. Requires an EGA card.

ALTBRNCH is a tiny, simple solution to the problem of having an AUTOEXEC file which must do different things depending upon which applications you want to run. This little program allows you to include additional commands in any batch file by holding down the Alt key.

WINDOWS 3 ICONS We've collected sixty assorted icons for Windows 3 and added them to this volume. These include icons for basic DOS operations, as well as icons for various commercial and shareware programs you can run under Windows 3. You can modify these with ICONDRAW from the previous Almost Free Software volume or with PBICON from this one.

CINEMA is a slide show program for image files. It supports any mixture of MacPaint, GEM/IMG, PCX, GIF, TIFF, WPG, IFF/LBM and MSP files, and drives display in up to 256 colours. It can be used with most of the popular super VGA cards, and includes a simple script language to allow you to create complex slide shows.

APPLE)(Journey back to those bygone days when Apple][+ clones were the state of the art. This amazing program emulates a 6502 processor in software and then runs a synthetic Apple][+ on it. Pretty well all the features of the hardware are supported, including the graphics modes. You can run just about anything that runs on a real Apple][+ on this thing, including games. Note that this program does not allow you to actually read Apple disks on your PC - you may need a serial cable if you wish to port existing Apple programs to your PC.

MUSIC EDITOR A small and extremely easy tool to use, this little music program will allow you to edit music scored using the BASIC PLAY notation. It uses WordStar-like editing controls, can play blocks while you fine tune them and is generally an awful lot of fun. Several sample pieces are included.

LONG PI is a tiny program which will calculate the value of PI to pretty well any number of decimal places you care to have it in. The C language source is included, and provides an interesting tutorial in handling numbers with high degrees of precision.

MEMO is a flat file database program for memos, notes, ideas and other bits of text. It allows you to search the database in a particularly intuitive way to find desired entries. If you have a lot of bits of text around you hard drive, you'll wonder how life got as far as it did without this thing.



LION AND CUB (FRAGMENT) FROM COLOUR CLIP ART 11

FUSE is a really nice program for Windows 3. It draws constantly moving abstract art in the background of your Windows desktop. Requires Microsoft Windows 3.

PBICON is a clever way to create and edit icons for Windows 3. It allows you to use PC Paintbrush as the actual editing tool, exchanging image fragments with ICO files.

SCREENPEACE is the last word in Windows 3 screen saver programs. Aside from being a fully configurable monitor saver, it can optionally display all sorts of incredible animated graphics while it's idling. The registration fee for this program will be contributed by the author to Greenpeace. Requires Microsoft Windows.

WORMWAR is a nice little time waster for Windows 3. An arcade game something like a mutation of snake and space invaders, it allows you to pop open a window and kill things whenever you feel like it. Requires Microsoft Windows 3.

WINWHERE is a file finder optimized for Windows 3. It will locate files based on any path specification and draw you a map to show you where they reside. Requires Microsoft Windows 3.

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ALMOST FREE SOFTWARE VOLUME 62

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JOUST This is a superb VGA implementation of the arcade game. Ride your ostrich to glory while you slaughter demons on all sides. Requires a VGA card.

SUPERSPY is a text browse program with more features than most word processors. You can bounce from file to file, shell out to DOS, cut and paste... your words will never be mere words again.

SPOOLER is the last word in print spoolers. It will hide in memory and intercept data bound for your printer, saving it temporarily to a disk file instead. Formerly lengthy print jobs will take a few seconds, and you'll be able to get back to work instantly. Meanwhile, the spooler will print your job in the background.

LANDER returns you to that most entrancing of tourist spots, the moon. However, now you can go in style, as this version of the classic game runs under Windows 3 with superb graphics and moderate sarcasm. Attempt to land amidst the craters without becoming one.

POPSPAWN allows you to pop out of any application into any other application with the touch of an Alt key and then pop right back to where you left off. This is the smallest and most reliable spawn program we've encountered thus far.

COKE We found this tiny file on a bulletin board. It purports to be the original formula for Coca Cola. We haven't tried mixing up a batch of the brew described herein, but there are certainly enough details should you wish to do so.

LUMPIES is a weird little maze game in which you run around in a three dimensional building killing robots. Sounds like Monday morning at the office.

ENHANCER is a clever little program which hooks into DOS and makes the DIR listing a bit more useful and informative – not to mention easier to read.

GO is one of the best computerized implementations of *go* we've encountered. While not the equal of a human opponent, it's a lot of fun should you have no humans around who want to give you a game. Once you have some experience of it, you'll probably find that *go* is the most enjoyable of games. If you want to learn to play *go* properly, we recommend that you find a copy of the book *Go For Beginners* by Kaoru Iwamoto, published by Penguin.

TAIPAI is a colourful implementation of the game of Taipei for Windows 3.

KFREE will show you how much free memory you have under Windows 3.

ROTO is a superbly irritating little puzzle which will probably kill a couple of afternoons for you.

NATIME is a small program which will tell you what time it is in the various time zones of North America.

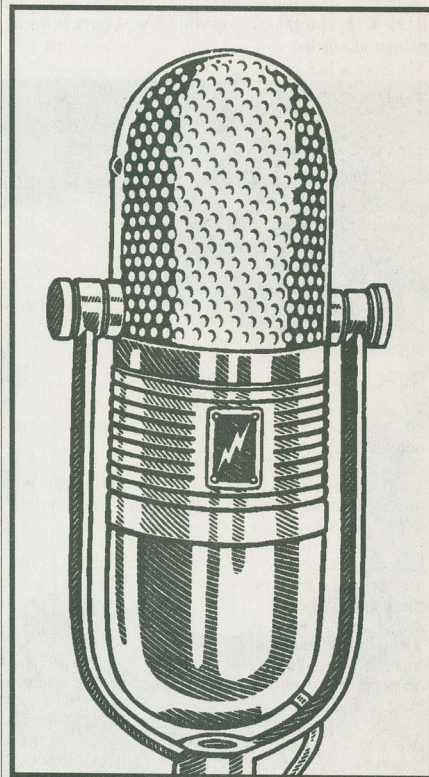
WINEYES is a very strange little Windows 3 application. It watches your cursor move around with large cartoon eyes.

FREDDY is a game not unlike Mario Brothers or Donkey Kong. Climb around the walls and try to avoid becoming lunch.

CHEDR is the easiest LaserJet soft font editor and font manipulator we've encountered. It's just the thing for creating a few special symbols or otherwise fine-tuning your desktop publishing fonts.

COLA calculates the change in the cost of living between different points in time. It's an interesting tool to help you make sense of the *real* changes in your buying power. It's a bit sobering, too.

ICONEDIT allows you to alter the appearance of the icons of applications under Windows 3. It includes complete instructions and a selection of sample icons to start with.



AKO MIKE FROM CLIP ART 18

BUGLE will play a host of bugle calls through your PC's speaker. This isn't the sort of software to change your life, but it's small and interesting if you stash it in your AUTOEXEC file.

SPEEDKEY is the smallest AT keyboard speedup program we've yet encountered. It puts the repeat rate of your keyboard into overdrive, speeding up all sorts of screen based applications. Source code is included.

CHAG is a complex and infinitely enjoyable graphic game. Prowl through an ancient and not quite vacant temple searching for treasure and trying to avoid the local monsters. Requires an EGA card.

BOXES is a handy pop up program which displays the various permutations of box characters on your screen, along with their ASCII values. It saves ages of looking for your code chart.

BELLS allows you to fine tune the bell sound of your PC to lengths which you might not have imagined possible. Transform a simple bleep into a symphony.

SCREENSAVER is the best and most flexible screen saver program we've found. It will blank your screen to avoid monitor burn, lock your keyboard to avoid inquiring fellow employees and it runs with pretty well any card.

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ALMOST FREE SOFTWARE
VOLUME 61

SHARKS is a splendid graphic arcade game. Swim around and collect things while you attempt to avoid becoming shark munchies. Just when you thought it was safe to use your computer again... Requires an EGA or VGA card.

HILOAD makes something of the bits of unused memory present on many late model AT and 386 systems. With HILOAD you can load your TSRs into this otherwise wasted RAM.

TREK TRIVIA is a trivia game which It knows things about the original Star Trek series that even Mr. Spock has probably forgotten.

TWO SONGS are tiny files... less than one kilobyte each... which play the themes from Star Trek and any number of spaghetti westerns.

PCBEAT is an amazing rhythm box and drum machine for your PC. It allows you to edit drum patterns and play them back through your PC's speaker with some stunning percussive sounds.

CALENDAR is one of the best... and simplest... reminder programs we've encountered. It fits in your AUTOEXEC.BAT file and tells you about what you have to do today.

INFOBAR is a tiny pop-up program which puts a movable ruler on your screen. The ruler tells you all sorts of useful things about what's happening just behind the glass of your monitor.

EDIT is a simple text editor for Microsoft Windows. You can use it to hack batch files, modify WIN.INI or enter a list of ways to kill cats.

CLX changes the way your PC clears its screen, transforming the simple act of fading to black into a brief adventure.

WCD is an astounding program for anyone who travels. Enter the locations of any two major cities on earth and it will tell you where they are and how long it'll take you to fly between them.

MOONFAZE Given your location on earth and the current date, it will draw the moon for you, including a map of all the major visible phenomena on its surface. Requires an EGA or VGA card.

PACHISI has been a popular game in India since before much of the rest of the world left the trees. Requires an EGA or VGA card.

TIC TAC TOE This is a three-dimensional tic-tac-toe game for Windows. It's sneaky as hell, too. Requires Microsoft Windows.

WAS keeps track of the things which have scrolled off your screen, buffering the vanished lines in expanded memory.

MEM is a little program to help you figure out what all the standard, extended and expanded memory in your system is *really* up to.

416 Residents of upper Canada, however, will find this essential. It will tell you where every exchange in the 416 area code is, what it's local to and whether calling it from any other exchange will incur the wrath of long distance charges.

PHONE is a simple, easy to use pop-up phone directory and it's available from within pretty well any other application.

PAINT BOX Allows you to draw pictures, edit PCX files for desktop publishing applications, create quick charts and graphs, whip up a few signs, ornament the company bulletin board and generally kill digital trees.

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ALMOST FREE SOFTWARE
VOLUME 60

TSRLABEL is a handy little resident utility which will allow you to print labels from within your favourite word processor, database manager or Mayan astrology program.

LIST has every feature a file browse program could ask for, plus a number that you'd never have thought of. Blows the TYPE command away.

FRAC is a Weltris-like game from Sweden. It has astounding graphics and splendid strategy... far better than the commercial version. You won't leave this one alone without serious provocation, a major system crash or repossession. Requires an EGA or VGA card.

FOURIER FUN You probably wouldn't have thought that Fourier synthesis was much of a basis for a game. Well, the author of this little program would disagree with you. Fourier Fun challenges you to match graphic harmonics. Requires an EGA or VGA card.

CHET is an EGA and VGA card character editor which will allow you to change and customize the text mode screen font. Requires an EGA or VGA card.

ASC128 is the best way yet to get high order graphics characters into your word processing documents. Simply blast an alternate key combination and select the characters you need from a pop-up window.

EXERCAL is a handy little calculator to help you estimate the number of actual calories you burn off while bicycling. It takes into account how you ride, where you ride and what the weather's like. Not for couch potatoes, this.

CROPGIF will become a central tool in your life if you like to collect GIF files. It uses a simple, mouse driven interface to allow you to crop fragments from larger GIF files, thereby pruning the messages and other dogma that no one really wants to look at from your megabytes of pictures. Requires a Microsoft compatible mouse.

BLAST is an indescribably good game. Going beyond breakout, arkanoid and all clones thereof, Blast will have you seeing bouncing balls in your sleep. Runs in the graphics modes of virtually all popular cards, including many super VGA cards in their 800 by 600 pixel modes.

DESKTOP is a file manager with a difference... it looks an awful lot like Microsoft Windows. If you're familiar with Windows you'll feel right at home with this handy little shell.

STARTSCREEN Computers don't live by bytes alone. If you'd like to see something other than your BIOS copyright when your system boots up, this program will create a self-booting picture to include in your AUTOEXEC.BAT file. It will accept most monochrome and sixteen colour PCX files as input... several are included. Requires an EGA or VGA card.

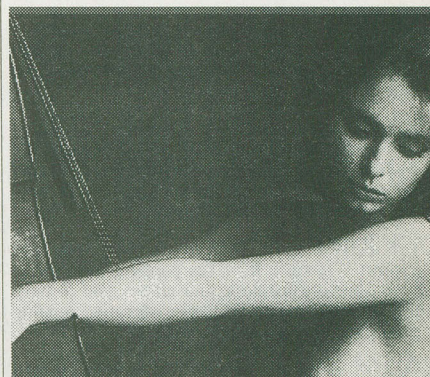
SIGN LANGUAGE is a handy tool for anyone wishing to learn American sign language. It will accept any ASCII text file and display it on your screen in signs.

CHEQUE MANAGER This is the last word in cheque book programs. So sophisticated it could keep Michael Wilson out of debt... almost. It will keep track of even the most disorganized chequeing account.

\$24.95 (TWO DISK SET)

ALMOST FREE SOFTWARE
VOLUME 59

GALACTIC BATTLE This is one of the most sophisticated alien killer games we've seen in many a mega-eon. It runs on any graphics card, will use a mouse or a joystick if you have one and your keyboard if you don't and is lightning fast. I love the smell of phasors in the morning...



CELLO (FRAGMENT) FROM COLOUR CLIP ART 12

LZEXE is so unspeakably brilliant one wonders why it wasn't thought of before. It will reduce the size of most EXE files by up to seventy-five percent without impairing their functions. This little jewel can free up megabytes on your hard drive with no real penalties.

T-RULER is a handy on screen pop up ruler for EGA and VGA cards which will flip either horizontally or vertically. Unspeakably useful, this.

WORD PERFECT TEMPLATES is a collection of pop up on screen keyboard templates for Word Perfect users.

TIMELOCK is a security system for your PC which doesn't require that you remember to activate it. After a preset period of inactivity, it locks your keyboard until you type in a password.

EXPLOSIVE is a screen blanker. However, whereas most screen blankers just blank your screen, this one pops into graphics mode and draws animated fireworks on it until you hit a key.

SMALL C Have you ever wanted to try your hand at C language programming? Springing a few hundred bucks for a compiler package may seem a bit excessive just to see what it's like. This little C interpreter is both inexpensive and a lot easier to learn than a full blown compiler. Includes a really extensive tutorial and lots of help.

ORIGAMI is a series of BASIC programs which will animate the steps involved in creating folded paper creatures. Requires BASIC.

TREE is a DOS file management shell which is unusually complete and easy to use. It lets you copy, rename, delete and execute files... and buckets more... all in menu driven comfort.

MUSBOX is a really simple little music composition program which will beep and squeak anything from Beethoven to the Grateful Dead through the PC's speaker. Requires a mouse.

WORKS is a superb integrated productivity package. It includes a word processor, spreadsheet, database manager, file security encryptor, disk utilities... all under one roof.

\$24.95 (TWO DISK SET)

ALMOST FREE SOFTWARE
VOLUME 58

PC-WRITE LITE might just be the perfect word processor. Far more powerful than many commercial packages, PC-Write Lite has a mix of features which makes it ideally suited for desktop publishing applications. It's painless to learn, aggressively supported and will run well on even the slowest PC.

RM_TREE is a disk pruning program which actually works. It allows you to wipe out subdirectories even if they aren't empty... all with one easy, wonderfully destructive command.

DISKLITE is fantastically clever, and a positive boon for anyone with a hard disk that lacks an activity light... hard cards are known for this. This tiny program flashes the caps lock light of your keyboard whenever a disk is accessed.

DISKJUMP will change the way you use Microsoft Windows. It makes popping from directory to directory painless, and allows you to have multiple copies of the Windows executive running in each directory you want to work in.

RALPH is an omnivorous file browser. It will accept straight ASCII, WordStar 5.0 and Word Perfect documents and let you cruise through them without having to boot up your word processor.

JUNGLE JACK is a VGA graphics game similar to Pipe Dream... without the copy protection. The object is to build a canal across the jungle before the river rises and washes away your plantation. Requires a VGA card.

CD LIBRARIAN is a small, easy to understand database manager for compact disc collections. Keep track of your tunes even if your library grows to immense proportions.

SNAPSHOT is a versatile text screen grabber program. It turns any text screen into source code for your choice of programming language.

FGRAB is a quick way to grab lines from a text file. Given a word processing document or any other text file, it will allow you to browse through it and copy selected lines to a second file.

EGADIGI makes your screen font look... well, digital. Requires an EGA or VGA card.

SND will keep your hard drive free of those nasty unwanted files that gather in the corners. SND... search and destroy... will cruise through all your subdirectories and wipe out offending files.

AUTOCON is an amazing little time saver. If you frequently have to use different CONFIG.SYS files to run different sorts of applications, this thing will pop up a menu and let you select the collection of drivers you want to use.

KILLFILE Isn't it nice to be able to unerase accidentally deleted files? Ever consider that someone else might be able to unerase your deliberately deleted files without your knowing it? This file killer kills 'em dead by overwriting every byte of your file with meaningless data before it bids it farewell.

GUTS is the one program no Windows user will want to be without. It draws all sorts of colourful abstract snakes, complete with user definable snake options, mouse control and so on. Not exactly a business solution, GUTS is hypnotic to watch none the less.

\$24.95 (TWO DISK SET)

ALMOST FREE SOFTWARE
VOLUME 57

BOUNCE is a three dimensional computer tennis game. Using superb EGA graphics, an optional mouse or joystick and high speed action, it makes an apparently simple concept exceedingly hard to walk away from. Requires an EGA card.

BLIND MAZE is a game which proves how much you can do with mere ASCII and a good plot. Travel through an infinitely complex maze as you try to avoid being lunched out on by the letters.

CROSSALL is a tiny but remarkably useful command. It will run any other command or program in every subdirectory of your hard drive.

OUTLINER is one of the most sophisticated outline processors available. It allows you to generate an overview of any report, article or other document to be written and then flesh out the details. This is a powerful writing tool for anyone who has to create polished, coherent prose in a minimum of time.

ASTROVIEW will show you the skies... or more precisely, the stars... for any day of the year from anywhere on earth. It's interactive and very, very interesting.

KEYREPEAT is a tiny program to set the keyboard repeat rate of your PC. It's amazing how this simple change can put word processors and other text based applications into overdrive.

MUGSHOTS is not terribly useful but it is a lot of fun. It allows you to create composite pictures of faces from a list of standardized components. Included are a number of sample faces in case you can't find one of your own.

GRAPHIC WORKSHOP is the last word in graphics programs. It views, converts, dithers, halftones and prints MacPaint, GEM/Ventura IMG, PC Paintbrush PCX, GIF, TIFF and EPS files and drives CGA, Hercules, EGA, VGA, ATI VGA Wonder and Paradise cards. It's an indispensable tool for graphics in desktop publishing. (Note that the most recent version of this program is always available on our GIF Users Toolkit disk.)

CARDEX is an electronic simulation of a Rolodex file. It's actually a sort of canned database manager specifically for the sorts of things you'd normally write on cards. This is a great tool for anyone who keeps a lot of lists or piles of papers.

FICTIONARY is a game for anyone who likes unusual words. It has buckets of them. The object of the game is to figure which clue matches a particular obscure term.

MOUSE LISTER is a file browser with teeth. It uses an elegant mouse interface to make prowling through text or binary files effortless.

FORTUNE COOKIE is an essential Windows application for anyone who feels his or her sanity slipping. It's a window which sits there and displays selections from its inexhaustible database of canned wisdom. Requires Microsoft Windows.

WINWHERE is a first class little file finder for Windows. It will locate any file spec and draw you a map of your hard disk to show you where the files in question are lurking. Requires Microsoft Windows.

CLOSER, RUN and CLEAN are a trio of tiny Windows utilities which will allow you to deal with frequently run applications quickly and without a lot of extraneous clicking. Requires Microsoft Windows.

\$24.95 (TWO DISK SET)

ALMOST FREE SOFTWARE
VOLUME 56

MEMORY is a Windows program which will show you how much DOS, extended and expanded memory Windows thinks you have free.

HANOI is a graphic demonstration of the solution to the legendary Towers of Hanoi problem. Requires Microsoft Windows.



CASTLE (FRAGMENT) FROM COLOUR CLIP ART 11

FIFTEEN is the classic number puzzle done for Windows. It's a great little time waster when you can't face Excel for one minute longer. Requires Microsoft Windows.

TREK is a classic Star Trek game made bolder still with the addition of EGA graphics. It's a rich, intricate adventure set against the backdrop of uncharted space. Sounds like a good plot for a TV show of some sort... Requires an EGA card.

GRAFCAT is the latest... and vastly expanded... version of our popular graphics catalog program. It prints 16 images to a page on any LaserJet compatible or PostScript printer, and works with a mixture of PCX, IMG, MacPaint and GIF files. The colour pictures get dithered. This is a great tool for users of desktop publishing software. (Note that the most recent version of this program is always available on our GIF Users Toolkit disk.)

DISK AT A GLANCE is a great little program for figuring out where all your hard drive space has gone. It lets you walk through your subdirectories and see what's stored where.

STARTER is a Windows application starter that's a lot easier to use than the main Windows screen if you use the same programs all the time. Requires Microsoft Windows.

WHEN is a time management tool which will let you set alarms for yourself, plan your days weeks ahead and generally make sense of a busy schedule.

HOTRES is a rather brilliant little program which will make any normal DOS program into a pop-up utility.

ALIAS is one of the most sophisticated DOS command line editors we've encountered to date. It replaces DOSEDIT with some powerful new functions.

REWRITE is a lifesaver for anyone who has a quad density, 1.2 megabyte drive. If you attempt to write to a regular 360 kilobyte disk in one of these things, it frequently becomes unreadable in a regular dual density drive. This program undoes the damage. C source is included.

SPICE is an extensive cross reference generator for spices and herbs. It helps you choose spices which will best complement your food.

CREEPS is a one of those apparently simple but maddeningly addictive ASCII arcade games. Requires a few hours to burn as you scoot between the blocks blasting the creeps. Requires a CGA, EGA or VGA card.

DIS86 is a diabolically clever machine language disassembler. It allows you to actually trace your way through the jumps and calls of a object file to see what everything does.

MOVE is a really reliable file mover. It copies your files from place to place and then deletes the originals.



SHANNON FROM COLOUR CLIP ART 12

LIFE is a really slick implementation of the classic simulation of life done for Windows.

VGAFONT will replace your boring IBM VGA font with a slick, modern looking one. Requires a VGA card.

ADULT TRIVIA is something like trivial pursuit with a one track mind. It's both entertaining and educational... and rude. Please note that this game is quite explicit in places... most places... and may not be suitable for young or sensitive users. If you plan to give this collection to the kids, we recommend that you delete this game.

CONQRDEX will generate a concordance index from any text file. It's great for creating book indexes and tables of content.

HOG is a glorious graphic pie chart which will visually display how your hard drive is being used. It spots the disk hogs. Requires an EGA card.

DQ is a file browser for database files. It works with DBF files from dBASE, FoxBase and all the other dBASE compatible programs. This is a genuinely essential program for anyone who works with database managers.

AGE will ask you questions about yourself and your lifestyle and tell you what your physiological age really is. It's rather sobering.

FREEKICK is a SideKick replacement. It provides you with a pop up calendar and calculator from within any application. However, it does so without tying up a lot of memory.

\$24.95 (TWO DISK SET)

ALMOST FREE SOFTWARE VOLUME 55

ASEASY is the latest version of the shareware spreadsheet package that has left the Lotus corporation shaking in its polyester boots. AsEasy is compatible with Lotus 1-2-3 and will use Lotus worksheet files. However, AsEasy is more powerful, easier to use and substantially cheaper. If you use Lotus you owe it to yourself to try AsEasy.

ATFLOPPY is a resident program which warns you if you attempt to write to a three hundred and sixty kilobyte floppy disk in a quad density AT drive. Saves considerable frustration.

WINDCHILL is a small program which calculates wind chill factors. This is a handy one to have when you want to justify staying inside during the winter.

QUOTE is a Windows application which says something clever each time it starts up. The clever things are stored in a dBASE compatible DBF file, allowing you to use them in other applications if you like. Requires Microsoft Windows.

TALK is the most sophisticated computer speech system we've encountered for the PC. It includes a program to speak real digitized words through the speaker, source code thereof, a program to record your own speech fragments, the schematic for the requisite hardware for the recorder and lots of sample words which can be strung together at the command line. Quite a blast.

SNAP is a simple Windows camera. Copy any part of a Windows screen into the clipboard at the touch of a mouse button. Requires Microsoft Windows.

DAYLIGHT calculates the sunrise and sunset times, plus sundry related information, for any day at any point on earth. Good for things like headlight-on times. Includes source code.

WEIGHTS AND MEASURES is a handy program which will generate a table of weights, measures and conversions. Saves a lot of thumbing around.

BEYOND TETRIS is a really exciting variation on the popular Tetris games. Requires a VGA card... the graphics are stunning.

RTM is a personal scheduler program, to-do list and calendar. It can be memory resident if you like, and it has a first class user interface. If this package can't organize your days it's probably time to retire to Tahiti.

START is an elegant way to start frequently used Windows applications. It's completely user configurable. Requires Microsoft Windows.

KWIKTAX is a beautifully executed 1989 Canadian income tax spreadsheet. It lets you work out your taxes as well as including features to let you try "what-if" calculations. If you're going to cheat, do it electronically. Requires the AsEasy spreadsheet package, included with this collection. Also runs under Lotus 1-2-3.

GENE is a genealogical program to help you trace your family tree. It goes back further than most people have relatives and includes fields for all sorts of interesting information about your antecedents.

\$24.95 (TWO DISK SET)

ALMOST FREE SOFTWARE VOLUME 54

SOAPBOX is a complete, exceedingly powerful word processor which is fast enough to use on a stock XT and small enough to run in 256 kilobytes of memory. It's capable of emulating WordStar... it will even read and write WordStar files if you like... and it's loaded with first rate text basing features that make it ideal for use with a desktop publishing package.

HOWTALL will take into account your child's sex, age and other factors and tell you how tall he or she should be.

WORLD is a truly amazing computerized atlas which will do more things than a paper atlas ever could, including providing extensive EGA graphic maps, calculating the distance between major cities and so on. An EGA card is required.

CUTPASTE will allow you to cut text out of one application and paste it into another. It's very flexible and extremely useful for desktop publishing, word processing and spreadsheets. Source code is included.

SPATH allows you to search for things along DOS's search path just like DOS does. A handy little tool, this.

VIZ is a dynamite little screen speedup program for 80286 and 80386 based machines. It vastly reduces the amount of time required to print to the screen from many applications, making things like word processors and database managers... not to mention DOS itself... seem to shift into warp drive.

EDISKEMS allows you to have a sophisticated EMS RAM disk with lots of features, including the ability to survive a warm boot with its data intact. Source code is included. Requires EMS.

MAXFIND is a great utility for finding strings within multiple text files. It includes a sophisticated search language to allow you to specify exactly what you want to search for.

ORGAN makes every key on your keyboard play a different note while you're running any application... or DOS. It's fun for a while, as well as being the ultimate in audible feedback.

EZDOSIT is a memory resident file manager which allows you to pop up a window from within any application and work with your files. You can copy, delete and rename files, change directories and so on. It's a real time saver.

DESKNAV is a Microsoft Windows program which provides a number of facilities which Windows didn't see fit to include. This is one of the nicest desk managers we've encountered to date. Requires Microsoft Windows.

LANCE is a prose style analyzer. Far from just telling you that you use too many possessive pronouns, it lets you test a text file for specific characteristics, including sexual bias and potential libel. No writer should be without it.

DECIDE is a simple program to let you try out a number of potential colour schemes for Microsoft Windows and select the one which best suits you. Neon is the house favourite. Requires Microsoft Windows.

PCMAN is a small EGA version of PacMan with all the speed of the arcade version. However, this one just gobbles dots, not quarters. It's sort of nostalgic.

\$24.95 (TWO DISK SET)

ALMOST FREE SOFTWARE
VOLUME 53

MONOPOLY is a first class implementation of the board game. Requires an EGA card.

EMS is an expanded memory simulator. If you have an AT or 386 system with extended memory, this little jewel will make it appear as LIM expanded memory for applications which require it.

MT expands selected parts of the text on your screen into huge letters. Great for working late at night.

CROSSWORD lets you compose and play with crossword puzzles in style. Requires Microsoft Windows.

MICKEY is a Windows screen clock which replaces the traditional Microsoft implementation with everyone's favourite fictional rodent. Requires Microsoft Windows.

RBREAK is somewhere between Breakout and Arkanoid. Requires Windows.

DKEY is a simple but powerful keyboard macro program, in many ways the equal of SuperKey and ProKey. Saves you ages of typing.

GRAFCAT prints hard copy of sixteen image files per page... along with their file names and such... so you can see what you've got at a glance. Requires a LaserJet Plus compatible printer.

FONTSUM will print up a summary page of all the LaserJet Plus soft fonts you have kicking around so you can tell what they all look like.

MAP will draw a map of all the hard drives on your system, telling you instantly how they're being utilized and how much space is free.

GRAVITY is a fascinating simulation of celestial mechanics. See how planets, stars and other celestial bodies interact in real time. Create your own universe... it's a blast.

EMCACHE is a memory cache program which runs in expanded memory. It can speed up hard disk operations, especially in applications such as database managers. However, it ties up no DOS memory doing so.

SCRABBLE is an implementation of the popular board game. Play against the computer. EGA card required.

POPHITS is a complete database of all the top forty singles and albums from the early sixties until the present.

SCALEMASTER is a guitar tutor program which will blow your socks off. Aside from helping you tune the beast, it will show you how to play every imaginable scale in all keys.

MILLEBORNE is an eye-popping implementation of the classic travel game. Requires an EGA card.

SPACE is a slick little asteroids game for Microsoft Windows.

BIORHYTHM is a program to compute your personal biorhythms, displaying the results in full colour graphics. Requires an EGA card.

S-TREE is a directory tree mapping utility which will show you what you've got on your hard drive, where it is and how much space it occupies.

TVSAT is a great program if you have a satellite dish, as it tells you where the satellites are.

\$24.95 (TWO DISK SET)

ALMOST FREE SOFTWARE
VOLUME 52

PC-AREA is the last word in telephone area code programs. Hit the alternate key of your choice and it pops up a window with all the provinces and states in North America, along with a comprehensive area code finder. Let your fingers hoof it in style.

FREEFORM is a data base manager for people who *don't* want to mess about with dBASE. It creates a free form data base which is easy to use, requires no set up and can be keyed by a trained chimp.

MAZE is a puzzle. It looks simple, but it's a real brain buster. The solution's included in case you get totally frustrated.

OHM-TSR is a handy pop up program which will work out resistor colour codes for you.

STACK is a DOSEDIT replacement from Australia. It keeps a stack of your previous command lines, plus it has a handy pop up window which lets you see all your previous commands at a glance.



POP CAN (FRAGMENT) FROM COLOUR CLIP ART 11

CREDIT is a credit card manager, suitable for use in business or to keep track of your personal finances. It helps you refrain from spending yourself into oblivion. Don't leave home without it. Requires Microsoft Windows.

STAR GOOSE is a strange little arcade game in which you fly a space ship over a strange alien world blasting things into cosmic dust. It's fast and the graphics are superb. EGA or VGA card required.

ALMANAC is a computerized version of the old farmers' almanac that usually accosts you while waiting in the supermarket checkout. Find out what the best days to drill wells are, bring up a host of useful charts and tables and follow the phase of the moon.

VIEW2 is a file view program with schizophrenia. It lets you scroll through two files side by side, allowing you to compare them or just to work with two documents at once.

DUSTY is the last word in Ventura Publisher style sheet utilities. It will create an exhaustive analysis of any style sheet. If you use Ventura you won't want to miss this one.

KBSPEED speeds up the repeat rate of your keyboard... and suddenly, all sorts of programs seem to go a lot faster.

RETPLAN is an RRSP and annuity planner and calculator. It lets you see just how much you'll retire with based on your annual contributions. It's one of the last ways going to get something past the government.

\$24.95 (TWO DISK SET)

ALMOST FREE SOFTWARE
VOLUME 51

ASCII is a great resident program for applications which require that you enter extended character codes into them. Rather than having to remember what the code for a U with an umlaut over it is, just pop up this window and select it from a table. Great for word processing.

DRAFTC is like AutoCAD without the price tag... and it doesn't need a math chip. This is a complete drafting package with pull down menus, mouse support and lots of features. It's great for applications in which you don't need all the power of a high end drawing program. Requires a mouse.

POLY is a really elegant little three voice music playing program which lets you compose songs with a text editor or word processor and halve them played through your PC's speaker in up to three voices. Sample songs are included.

TRICAL is the most sophisticated pop up calculator program yet devised. Outthinking SideKick and all the commercial calculators, this one will do things even real calculators can't get together.

BANANOID is staggering. It's a VGA game which makes Breakout not only interesting but addictive. Mere words fail to describe the limitless time wasting potential of this thing. Suffice it to say that if you own a VGA card and a mouse and go through this life never having play Bananoid, all future incarnations of your spirit will laugh at you behind your collective backs. Requires a VGA card and a mouse.

CLIP allows you to extract sections of GIF files and make them into new, smaller GIF files. It's a great tool if you use our POSTGIF program to create desktop publishing clip art from GIF files.

EGAIN is the last word in Tetris programs. The ultimate falling shape puzzle, this features colour, extended shapes and a plethora of exciting features. Requires an EGA card.

FREEMEM is a dandy little Windows program which puts a window on your screen to tell you the current amount of free memory available to your applications. No computer should be without one. Requires Windows.

NTERNIST is a fascinating and oftentimes useful package to help you figure out... if not cure... what ails you. Give it your symptoms and it'll try to diagnose your condition. This is *not* a substitute for a real physician, but it's great if the provincial health care plan has put you seventy-nine places back in the waiting list.

PUZZLE is a Windows program which takes one of several graphics, scrambles it into little bits and challenges you to re-assemble it. Quite a decent little program, this. Requires Windows

SUBMIT is an instant batch file. It allows you to run multiple commands at one time from the DOS prompt simply by separating them with colons. An essential gadget, this.

TIME puts a digital clock into a Windows screen. Takes up less space than the one with hands does, and it looks slick. Requires Windows.

TODDY is a DOSEDIT replacement. It adds a sophisticated command line editor to DOS to allow you to recall and edit previous commands. Saves buckets of typing and uses WordStar editing commands.

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ALMOST FREE SOFTWARE
VOLUME 50

BAK will wander through your hard drive... every subdirectory, no matter how well buried it might be... and wipe out your BAK files.

CHAIN will tell you how much space any file on your disk occupies. This sounds like much ado about nothing, but CHAIN actually tells you how many clusters a file occupies, and, for the technically curious, where said clusters lie.

CUBE is a useless program that runs under Windows and displays a constantly rotating three dimensional cube. Despite its uselessness, everyone we know who has it runs it a lot... no idea why. Requires Windows.

DUNGEON is an ASCII game that lets you cruise through a complex, multiple layer dungeon picking up things and killing creatures. Requires that ANSI.SYS be installed.

IBM_SCRN is a downloadable character set for the Epson FX printers... and all compatibles... which emulates the PC's screen graphics characters. Make your screen dumps look like screen dumps rather than ASCII stew.

JOT-IT is the most flexible, interesting little resident note pad program we've come across. Loaded with features, it will find a warm place on your hard drive... right next to the platter bearings.

MINDREADER is the oddest word processor ever written. Especially designed for people who don't type too quickly, it uses artificial intelligence to attempt to anticipate what you'll say and fill in things for you. It sounds a bit far fetched, but the beast works.

POSTGIF is the latest version of this powerful program for turning GIF files into desktop publishing clip art.

PURGE is a handy little utility for selectively deleting files.

QCRT will speed up the screen speed of most machines by quite a bit. This makes DOS and many other programs which print through the BIOS really shift into overdrive.

SLITHER is a version of the popular snake game written especially for the EGA card. It's a bit warped, too... there's a frog involved. Requires an EGA or VGA card.

SPEED will speed up the screen display of an EGA or VGA card even better than QCRT, above. Includes the ASM source in case you like to hack.

CHEMVIEW is neat even if chemistry usually bores you into catatonia. It displays complex molecules in three dimensions and rotates them for you. Includes a selection of sample molecules. Requires EGA or VGA card.

FONTINFO is a DIR replacement that only wants to know about LaserJet soft fonts. It will find all of the soft fonts in a directory and tell you about them. Great for desktop publishing.

DROPCAPS are also great for desktop publishing. Consisting of twenty six little PCX files, they can be inhaled into Ventura, PageMaker... any package that uses the popular PC Paintbrush image file format... to provide you with beautiful, ornate large caps from A through Z.

THESAURUS is a computerized thesaurus program. Give it a word and it'll find you a selection of others that mean something like the same thing. Includes a huge dictionary.

\$24.95 (TWO DISK SET)

ALMOST FREE SOFTWARE
VOLUME 49

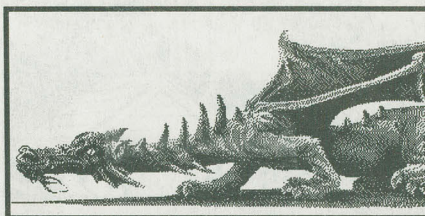
PHONES is a Windows application which keeps track of telephone numbers... it'll even dial 'em for you if you have a modem. Requires Microsoft Windows.

BRAIN evaluates how much of your thought processes are left brain, how much are right brain and how much are mixed brain. Requires a brain.

LM is the best mailing list program and label maker ever written. If you run a small business or send out newsletters, this program will change your perception of the universe. dBASE compatible.

ONEKEY is a keyboard macro program. It stores up to fifty strings, each one callable with the key combination of your choice.

ALDO is a game in the tradition of Mario Brothers. A little fellow with a beard leaps over barrels, climbs ladders and goes for the gold. Requires an EGA or VGA card.



DRAGON 4 (FRAGMENT) FROM CLIP ART 18

POPDBF is a pop up utility which allows you to browse through dBASE, Clipper, Foxbase and compatible database files from within any application.

TIKLER is one of the nicest tickler programs we've encountered. It reminds you of up to three hundred events in the future, without knotted handkerchiefs, bits of string or things written on your arm.

CAITY is small and so brilliantly pointless that we had to include it. It's a resident program. Run it and it plays a different musical note for every key on your keyboard. It's a delight to listen to as you type DOS commands... a veritable symphony in WordStar.

CONNECT4 is the best and most ruthless computer implementation of this popular game.

PALETTE allows you to set the colour palette in Windows sensibly. If you don't know you need this program you don't know how badly you do. C language source code included. Requires Microsoft Windows.

LIFE is a three dimensional version of the classic program in which a colony of creatures lunch out on each other. C language source code is included.

TRI-MAZE is a blast. It draws complex mazes and then challenges you to solve them.

PERIODIC displays the periodic table and lets you scan a cursor over it to get detailed information about each element. Requires an EGA or VGA card.

FANS Pilot a space ship through a field of waving fans catching bouncing loonie dollars as you go. An EGA or VGA card is required.

CHESS is a three dimensional chess game which actually allows you to move the pieces around, rather than just typing in co-ordinates. This has to be the last word in computer chess. Requires an EGA or VGA card.

\$24.95 (TWO DISK SET)

ALMOST FREE SOFTWARE
VOLUME 48

DRIVEL is a brilliant addition to any office. It produces very meaningful sounding text which is actually pure drivel. It will happily generate as much text as you want, suitable for use in memoranda, reports, letters and year end stockholders portfolios.

CPRINT is the ultimate C source file printer. Aside from generating first class hard copy listings complete with headers, footers, page numbers and so on, it will also generate an index and a table of contents for any source file.

EGARULE pops a ruler up over any EGA text screen. You can position the ruler where you need it, and use it for the accurate positioning of text in different applications. It's amazingly handy. Requires and EGA or VGA screen.

INVENTORY is a home or office inventory program which maintains a running database of your possessions. It keeps track of what everything's worth, and provides you with an estimate of the replacement costs. Reduces potential "negotiations" if you have to make an insurance claim.

JDOS will pop a command line up from within most applications. However, it does a number of clever things to allow you to have all the DOS memory in your system available for applications run from within other applications.

MORTGAGE is a powerful mortgage program. It does a number of types of calculations, and will print hard copy reports. It's great for doing "what if" plans to find ways to slaughter your mortgage quicker.

PIZZA will teach you to make pizza at home. It contains a variety of recipes and tips. Avoid getting anchovies in your disk drives.



ANNA (FRAGMENT) FROM COLOUR CLIP ART 12

POSTGIF is the best way of generating black and white printouts from full colour GIF files. This program creates true halftones... not dithers... from GIF files and stores them as EPS (encapsulated PostScript) files. These can include previews for use with Ventura publisher, too... you can use GIF files as black and white art for desktop publishing. If you've tried our Colour Clipart disks, you'll want this program. Requires a PostScript printer.

SLEUTH is a fascinating graphic ASCII game. A murder has been committed in an old house. There are various odd characters around, and various clues. Your task is to wander around the various rooms, check out the clues and unmask the villain before you get crunched. The game changes with every playing, and you can use your own cast of characters if you like.

SORTDEM is a particularly interesting program. It illustrates the process for sorting a list of words using five of the most popular sorting algorithms. You can see how each one works, and you'll understand why each one is preferable for some applications. C language source code is included.

\$19.95

ALMOST FREE SOFTWARE
VOLUME 47

LETTERS 'N LABELS is a fabulous mailing list manager if you have moderate sized lists to keep. It will store them in a custom database, let you update the list and print out labels whenever you need them.

ARGH is the sound that most people make after playing this puzzle game for a while. It's just a series of sliding blocks, but it'll drive you mad trying to solve it..



WELL (FRAGMENT) FROM CLIP ART 18

DERASE is the most comprehensive file un-eraser we've seen so far. It handles everything from floppies to hard drives of up to thirty two megabytes, and it tells you if your files have been trashed and are therefore unrecoverable.

HPPS is a PrtSc replacement especially designed for owners of HP LaserJet Plus compatible laser printers. Includes ASM source.

FINDER is a Microsoft Windows utility which locates files anywhere on your hard drive.

DO-ONCE is a program which can be set up to run specific applications, utilities or batch files at specific times. It will, for example, automatically back your hard drive up to a streamer every Friday afternoon once everyone has gone home. This is the most flexible and reliable one of these things we've found to date.

LAST RESORT keeps you going when your computer hangs. It will get you back to DOS, copy the contents of a RAM disk onto something more permanent and restart your heart when your system appears to have locked up solid.

AXEL-F plays the theme from Beverly Hills Cop. It's not all that useful, to be sure, but it's small and fun. Requires BASIC.

LIFETIME is a serious program which uses solid statistical research to estimate your life span based on your health and lifestyle... it can be a bit sobering. Requires BASIC.

POPDATE is a really well executed pop up calendar which shows you the current, previous and next month for any month you like.

800K uses the high density drive of an AT or 386 based machine to format normal low cost dual density floppies to hold eight hundred kilobytes worth of data, or more than double their usual capacity. It's a great money saver, considering the price difference between these and quads. Includes ASM source.

GLEANERS is a complete index to National Geographic magazine from 1957 through to 1987, along with a really superb database program to search for things by subject, place and so on. It's great for research, and essential if you've been saving back copies for a while.

\$19.95

ALMOST FREE SOFTWARE
VOLUME 46

PAINTER'S APPRENTICE This is a complete implementation of a MacPaint style paint box program for the PC, equal or superior in many ways to the original... and a lot easier to use than is PC Paintbrush or Microsoft Windows Paint. This is a phenomenally enjoyable program equally suitable for a bit of image hacking or for serious art. It's a must for desktop publishing. Requires EGA or VGA card and a mouse.

DGTERM is an immensely clever program which pops up a telecommunications terminal from within any application and allows for background XMODEM and YMODEM file transfers.

FINANCIAL PARTNER is a storehouse of financial planning utilities. It will work out amortization tables for loans, help you plan annuities and so on. No one with more than twelve dollars should be without this package.



WELL (FRAGMENT) FROM CLIP ART 18

FR386 is the fastest, slickest and most stunning fractal graphics package we've ever seen. It includes a zoom box which lets you move successively closer to the images you create. Requires an 80386 based computer and EGA or VGA card.

HPCALC runs under Microsoft Windows and gives you the complete functions of Hewlett Packard style programmable scientific calculator. No number will get away from you once you have this thing running.

LOOKFOR is a powerful text search utility which will find selected strings of text in any number of files. It's a useful research tool... and a great asset for people who can't remember where they last saw something.

QUICKCOPY is a replacement for the DOS DISKCOPY program. It copies disks in about half the time, and allows for multiple copies of the same disk without reading the original for each one.

RACECAR stands proudly in the tradition of brilliant public domain ASCII games. Using nothing more than text and colours, it allows you to drive a speeding car through a twisting, debris strewn race course until you finally pile up on the walls or oil slicks.

TIFFANY is the first really workable screen capture utility for Windows we've encountered. It allows you to create graphics files from any window on the screen.

TRAN is a rather astounding piece of work. It reads text files... through the speaker of your PC, in English.

ZAPDIR kills whole subdirectories in a single shot. It ends the annoying requirement of DOS that you manually wipe out all the files and sub-sub-directories in a subdirectory before you remove it.

\$19.95

ALMOST FREE SOFTWARE
VOLUME 45

POPDOS2 is a pop up DOS shell. You can rename, delete, type and generally meddle with files from within any application. It can save your life when your disk is full and your file hasn't been saved.

CALLFOR is a resident equivalent of those pink message slips that proliferate around offices... just the thing for an over worked receptionist, especially one with bad hand writing. It can be popped up from within a word processor or other application when the phone rings.

CLEARCUT will scan your word processing files and suggest places wherein you've used more complicated wordings than you should have. It helps to simplify your writing and make it easier to read.

CONFMT is a resident disk formatter. It allows you to format floppy disks as a background task while you run normal programs.

FLEES is like Space Invaders on acid. It's blindingly fast, with brilliant graphics and some really bizarre aspects. Requires an EGA or VGA card.

PALMEGA is a computerized palm analysis program. Better than an old lady with a crystal ball, it will tell you how long you'll live, how rich you'll get and whether or not you'll meet a tall, dark stranger who'll try to sell you swamp land in Florida. EGA or VGA card required.



WELL (FRAGMENT) FROM CLIP ART 18

P4UP will print four pages of normal text on a single sheet of paper on most laser and inkjet printers.

SHFTPICK is ideal for people with a lot of resident programs on their hard drives. It allows you to hold down the Alt key and bypass loading them when your system boots up.

MDIAL is a memory resident dialer program and phone number database. Connected to a modem, it allows you to dial voice calls without actually touching a phone.

SMOOTH is the leading edge of text browsing programs. It will smooth-scroll back and forth through any text file. This may seem like overkill... well, it is, actually... but it's awfully neat to watch.

VALET is the best DOS shell program we've encountered. It will move, mass copy, delete, rename and generally handle the files on your hard drive in menu driven comfort. It's ideal if you don't like typing in commands.

WIPE totally destroys files on your disk so that they can never, never be restored and looked at again. It's an essential tool if you deal with sensitive data.

YEARCAL creates calendars for any month of any year of the twentieth century. However, it creates more sorts of calendars than you can possibly imagine... in sixteen languages, including Texan.

\$19.95

ALMOST FREE SOFTWARE
VOLUME 44

BCOPY is one of the cleverest copying programs around. It hides in the background while it's working, so that immediately after issuing a copy command your DOS prompt returns and you're ready for whatever's next. A great little time saver.

BDS is a slick pop up electronic engineer's calculator. It handles things like wavelength, capacitance, radio equations and so on.

CALCQF analyzes your system and figures out how much you can speed things up by changing the refresh rate of your memory without crashing your machine. Then it generates a small COM file to include in your AUTOEXEC file.

JIVE translates any English text into jive.

LUM is a sophisticated sideways printing program which is great for spreadsheets or any application wherein regular paper just isn't wide enough. It supports multiple fonts, effects and so on. Requires an Epson FX-80 compatible printer.



SIRTIS (FRAGMENT) FROM CLIP ART 18

NJFRERAM will show you how much free memory you have from moment to moment up in the upper right corner of your screen. Great for spreadsheet users, amongst others.

ORDER changes the order in which files come off your disk when you type DIR. This allows you to pre-sort your directories, or adjust them in any order you like to make frequently used programs boot more rapidly.

PYRO we've had fireworks programs before... but this is the best. It does EGA fireworks, complete with sound effects, and is truly glorious. Includes C language source code. EGA/VGA card required.

SOT is the son of Tetris, the addictive game from the Soviet Union. This one is even more devious.

STYLIST is an essential tool for any Ventura Publisher user. It allows you to edit, manipulate and print out any style sheet.

TONTO is a SideKick-like program with a host of features, including a clock/calendar for any year since the middle of the sixteenth century, an ASCII chart and a printer setup program.

MR BOSTON is the ultimate bartender. It holds recipes and complete directions for zillions of mixed drinks... from the common to the delightfully bizarre... and provides you with an outstanding user friendly program to access and even add to the list.

\$19.95

ALMOST FREE SOFTWARE
VOLUME 43

MAGMA is a truly weird graphic arcade cum adventure game. Tunnel through the depths of the earth, contact spies and try to assemble all the fragments of your secret document.

BANKER will keep your chequebook in balance... as well as anything short of divine intervention can.

FONTFILTER adds special effects to LaserJet softfonts. Included are such effects as drop shadows, enclosing boxes and even blood dripping from each character. Also includes the complete C source.

READRITE is a real time readability analyzer. A resident program, you can pop it up from within your favourite word processor and get a readability index for the contents of your screen. Very slick.

CALC is the nicest pop up programmer's calculator we've encountered... and it's pretty hot for anyone else who has to deal with numbers too.

CARDFILE is a little pop up database program which will keep track of people, places, phone numbers... it even dials your phone.

RECORDER will keep track of the frequency of access of the files you use to help you decide how best to use a RAM disk.

BARMENUS is a system to compile and implement Lotus style menus in applications other than Lotus. It's a great toy for die hard 1-2-3 users.

SNIPPER is the slickest text cut and paste program we've encountered to date. Copy text from the screen of just about any application into just about any other one.

SWEEP will execute any command you like in every sub directory of your hard drive.

CONFIG is splendid. It lets you alter the way your CONFIG.SYS file is interpreted by DOS when your system boots up. You can exclude specific drivers at boot up time to free up memory space.

Z80XASM is an assembler which runs on a PC compatible system but assembles ASM source code for the Z80 microprocessor.

HERCSAVE is the most reliable Hercules screen blanker we've seen. Save those green tubes.

FSEE is a quick and nasty way to see what LaserJet fonts look like without having to download them to a laser printer.

OKSCR is a really elegant way to get reliable screen captures from graphics applications. Writes to PC Paintbrush compatible files.

VALSPEAK translates English into valley girl talk. Gag me with a spoon.

TED is a very small text editor... two kilobytes is very small.

EGALINES is a collection of tiny utilities which will set your EGA card to different line sizes so you can see what text looks like in the higher resolution modes. Includes 12, 25, 35, 43 and 50 line modes.

EGAITAL puts your EGA screen in italics mode. Not blindingly useful, but only a hundred bytes long.

PCXSLOOP is a file reader and printer for PC Paintbrush PCX and PCC files. Let's you check 'em out without loading the whole ZSoft circus. Handy for use with OKSCR, above.

\$19.95

ALMOST FREE SOFTWARE
VOLUME 42

FORMATQM is a very, very fast disk formatting program.

FIREWORK blanks the screen after a period of inactivity and shows you fireworks until you do something. Requires Microsoft Windows.

SNAKE is the best snake game ever written.

BELL makes the beep in your computer sound slick and sophisticated.

CALLTIME will dial the atomic clock in Ottawa and set your system clock accordingly. Requires a Hayes compatible modem.

CASE will change a text file to all upper or all lower case, strip the WordStar bits and more.

CDTO provides a simple way to locate files in other subdirectories and then go to their locations.

CLOCK is the biggest resident screen clock in creation.

DDATE is a cursor driven date setup program.

DEV shows you all your device drivers.

KTIMER times the execution of any program to the nearest hundredth of a second.

LISTFRAG shows you how fragmented your hard drive is, allowing you to decide whether it's worth running a defragmenter program.

NREFRESH slows down the refresh rate of your system to increase the speed of your machine.

RAMVIEW is a resident program that lets you pop into a hex and ASCII dump of your system and page through your RAM.

REPEATS locates identical files in a complex hard drive system, allowing you to free up some disk space.

SETALARM wakes you up at a predetermined time.

SILENCE kills the speaker of your PC.

STEPDOS allows you to step through the execution of a program one DOS call at a time, with an informative display at each pause.

VTREE2 shows you a map of your system and the sizes of your subdirectories. Great for pruning.

WATZITDO returns information about the multifarious alternate key combinations on the PC.

WF is a wild card find program that searches for files on your hard drive.

WORLDTIM lets you see the time anywhere in the world.

WPHD disables writing to your hard drive temporarily, protecting it from viruses to some extent.

XPANDISK creates a very sophisticated, variable size RAM disk in expanded memory.

TUNEUP uses your PC's speaker to generate precise pitches for tuning stringed instruments.

FORM generates business forms.

TCAP captures text screens, but makes them into GEM/IMG files suitable for use with Ventura.

\$19.95

ALMOST FREE SOFTWARE
VOLUME 39

BOOM is a program to display fireworks on your screen. You probably don't think you need one of these... most likely true, but it's fun to watch. Requires a CGA or EGA card.

COLORDIR is a very slick... and exceedingly fast... sorted directory program which uses screen colours to make large directory listings easier to see at a glance.

DIGCLOCK is a huge screen clock which reads out in seven segment numerals. Easily read from across the room, or across the street with a good telescope.

DISPINFO is a C source file for programmers. It's a routine to allow your code to figure out what video card is in the computer it's running on.

ED is another C source file, this one for the standard unix ed text editor. It has been reworked to compile under Turbo C, and will serve nicely as the basis for a word processor.

EGA2RAM runs the BIOS of your EGA card from fast RAM rather than slow ROM. It speeds up your screen quite noticeably with no snow or other drawbacks. Requires an EGA card, ASM source code included.

FASTGIF is a GIF image file reader. GIF files are glorious colour picture files which must be seen to be really appreciated. We've included a GIF file of a mandrill so you can see what they're up to. Requires an EGA or VGA card.

HP-SLASH reduces the size of LaserJet soft fonts... and their resultant download time... by allowing you to selectively remove unused characters from them. This is an essential tool for anyone using a LaserJet compatible printer.

MAXI.EXE is the answer to every "insufficient disk space" message in creation. It formats up a normal double density floppy to hold four hundred and twenty kilobytes, and a quad density disk to hold almost a megabyte and a half.

PC-POOL is a really well executed pool simulation. The ballistics of the balls is very nearly perfect, and the user interface is well thought out.. Requires a CGA or EGA card.

REMINDER is a memory resident appointment calendar which pops up at the touch of an alternate key. It also features a screen clock which can be enabled or disabled at will.

RN is the best way to move around the subdirectories of a hard drive ever invented. Rather than having to type in complex paths, RN allows you to move around in menu driven comfort.

SAY is the best speech program we've encountered for the PC thus far. It comes with a host of phrases, including the all but essential "beam me up, Scotty". Good for disturbing your stupor in the morning.

VFM will warm the hearts of Ventura Publisher users. It allows you to add and reorganize fonts for this popular desktop publishing system without any sweat, bother or keying of batch files.

MCOPY is a replacement for the DOS COPY command which copies files to floppies with maximum space efficiency, a prompt to swap floppies when the disk is full and full CRC checking to make sure that what you see is really what you get. This is an essential utility.

\$19.95

ALMOST FREE SOFTWARE
VOLUME 38

CALENDAR is a perpetual calendar running from the middle of the sixteenth century up until way past the age of Star Trek. This program will show you when important dates fall in the years of your choice as well.

CPM2DOS will actually read files from the disks of most CPM systems onto your PC. Unlike commercial packages which purport to do the same thing, it includes a facility for creating custom formats.

GCAP is the ultimate graphics screen capture. This resident utility will create GEM/IMG paint files from anything on your tube, suitable for use with Ventura, amongst others... an essential gadget for desktop publishing. Works with EGA monochrome, CGA and Hercules cards.

MACSCOOP is an updated version of the popular MacPaint file reader and features support for Epson FX, Hewlett-Packard LaserJet+ and PostScript printers and for EGA, CGA and Hercules display cards. It will let you look at and print any MacPaint image file. We've included a few to get you started.

GEMSCOOP is very much like MacScoop, above, and has the same features for reading and printing GEM/IMG paint files. A really handy tool for desktop publishing.

MAC2IMG converts MacPaint to GEM/IMG paint files for use with Ventura, among others, allowing you to access megabytes of public domain clip art. Handy for use with IMGCUT, GemScoop and Address also in this collection.

MEMO drives a PostScript device to generate truly eye catching memos. It accepts raw text or WordStar files and prints them sophisticatedly.

FONTS is a collection of our favourite EGA font programs, which will reduce the screen characters of any EGA compatible display adapter. Included are Script, Computer, Future and others. Also included is EGAFONT allowing you to create your own font programs.

ADDRESS is a vastly enhanced resident envelope addressing program which allows for custom printer configurations and either standing text or graphics of your choosing for the return address.

VCHECK will do a CRC check of the sensitive system files on your hard drive each time you boot your machine, ensuring that none of them has been infected with viruses.

IMGCUT extracts fragments of GEM/IMG paint files for use with desktop publishing and other applications which use this image file format. You can pre-crop pictures to save disk space and time and can also make graphics files for ADDRESS, also in this collection.

PINPRESS prints text very small on an Epson FX-80 compatible printer and allows you to cram up to sixteen kilobytes of text in two columns on a single page and keep it readable.

SMALL is the PinPress for laser printers. This thing will print about four standard pages of text on a single sheet of paper... rather small, of course. Works with any PostScript device.

\$19.95

ALMOST FREE QUAD
VOLUME 1NEW
IN THIS
CATALOG

A typical Almost Free Software collection unpacks to about a megabyte of software. This collection unpacks to about four megabytes, and costs no more. It includes a selection of applications which are too big — or in some cases just too unusual — to include in one of our regular disks. We hope you'll agree that this collection is a really excellent value.

WISDOM It's a bit hard to describe this program in mere words. Accessing a database of about a megabyte of esoteric knowledge, it will provide you with gems of insight on subjects as diverse as cunning, ruin and non-being. This thing has more quotes and epigrams than a Murphy's Law poster.

APPLE] [This is a complete emulation of the Apple][+. It will run on any PC compatible, and will run pretty well any software which formerly ran on an Apple][+. Complete assembly language source code is included. Note that this package will not enable your PC to actually read Apple disks. If you wish to run Apple software currently on Apple disks, you will need a serial cable to port the programs to your PC.



AKI (FRAGMENT) FROM COLOUR CLIP ART 11

EASY FINANCE is a personal accounting system along the lines of Quicken — but without the price tag. It will help you keep your chequebook in order, help you avoid overdrafts and generally manage your money in a professional, serious manner. It will probably save you the cost of this disk in service charges alone.

GALAXIE LITE is a full features word processing package which is easy to use. If your word processing runs to letters, reports and other documents which do not require the extensive formatting... and equally extensive learning curve... of WordPerfect, you'll love this program.

ALBUM TRACK is an amazingly sophisticated program to keep track of a large collection of compact discs, records or tape. It allows you to search and print out the database and features an intuitive user interface. This is just the program should your collection of compact discs expanded to exceed your personal memory capacity.

WAMPUM is a menu driven dBase compatible database manager. Capable of doing everything that its expensive commercial counterpart can, it adds a really easy to use menu driven interface.

AS EASY This is the latest version of this popular spreadsheet package. Emulating Lotus 1-2-3, As Easy lacks the merest vestige of copy protection, and it can do things which many Lotus users only dream of. In addition, of course, for the price of one copy of Lotus you can register an officeful of copies of As Easy.

GRAPHIC WORKSHOP As there was a bit of room left over on the second disk, we've included a copy of our popular image file manipulation package. This is just the thing for handling desktop publishing graphics, viewing rude GIF files and printing pictures, among other things.

\$24.95 (TWO QUADS)

HARD DISK SURVIVAL KIT

If you have a hard drive you can have all sorts of powerful utilities and programs installed in your system to make use of it more efficiently. We've collected the best of these utilities on a single disk to help new PC users get the most from their hard drive systems. Please note that some of these programs are included in our other almost free software disks. Descriptions of them are provided elsewhere in this catalog.

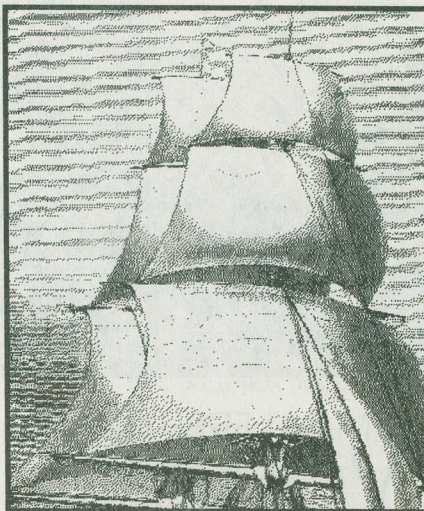
HGC Colour card emulator for Hercules
ADDRESS Resident envelope addresser
WHEREIS Hard drive file finder
SIZE File size finder
SETUP Resident Epson printer setup
RENDIR Subdirectory renamer
POPCAL Resident perpetual calendar
CLOCK Screen clock
EDWIN WordStar like editor
NANSI Screen driver
CACHE Disk cache
RAMDISK RAM disk program
LPTX Printer redirection
MURPHY Foolishness and wisdom
LOCKERUP Security system
BOTH Printer paper saver
PCWINDOW Resident grab bag
PINPRESS Prints things very small
NOTEPAD Resident notepad
FREE Free space finder
HOTDOS Multiple tasker
BLANK Screen blanker
K9 Another resident grab bag
LAZY Menu generator
UNWS WordStar converter
MORTGAGE Measure of your indenture
LOOK File viewer
PCBW Colour killer
VTREE Hard disk map
VFILER File manager
POPCALC Resident calculator
DOSEDIT Command line editor

\$19.95

SLOTH Z80 DESIGN SYSTEM

If you've ever wanted to learn about the real technology of computer design, here's your chance. Alternately, if you need a small, dedicated microprocessor system for custom controller applications, this is the slab of fiberglass you've been waiting for.

The Sloth is a dedicated microcomputer designed for custom applications. It features a Z80 processor, two kilobytes of static memory, two kilobytes of ROM, a three channel programmable timer and twenty-four lines of I/O. It drives a six digit LED display and a speaker, but you can add all sorts of other peripherals to it.



PAGE 39 (FRAGMENT) FROM CLIP ART 18

Your imagination is the only limit to what you can do with a Sloth board.

You can't run Arkanoid on a Sloth, but you can learn to develop dedicated microprocessor firmware on one. With it, you can enter the exciting world of microcontroller design and programming. The Sloth will help you learn how to create real world microprocessor hardware applications.

If you're already familiar with Z80 machine language programming, the Sloth is a great platform for creating your own dedicated control applications.

The Sloth package includes a bare Sloth board, a bare LED display board, a complete parts list, stuffing instructions and extensive documentation to get you started writing programs to run on it. This kit does not include the parts required to build up the Sloth, but we've designed the board to use easily available components.

In order to develop programs for the Sloth, you'll need a basic knowledge of Z80 programming and a system to assemble Z80 code and burn it into 2716 EPROMS. We're able to offer several approaches to this, including our Z80XASM package on Almost Free Software volume 43, allowing you to create object code for the Sloth on a PC.

\$37.95

ALMOST FREE LASERJET FONTS

There hasn't been a Ventura user yet born who hasn't cried out for more fonts. These collections should silence even the most obstreperous of them. We've assembled the strangest fonts we could find... add these typefaces to your desktop publishing chapters and no one will miss them.

Included in each of these collections are complete instructions for installing them in Ventura Publisher. These fonts are suitable only for use with LaserJet compatible laser printers.

LASERJET FONTS 1

Amityville 18 Point
 Avantis 18 Point
 Basque 18 Point
Begotten 18 Point
Big City 18 Point
 Centurion Medium 18 Point
 Channel 18 Point
Channel 24 Point Oblique
Copper 18 Point
 Courier 18 Point
 GalaxyGlue 18 Point
 Garnet 18 Point
Gillie 18 Point
 Olivia 18 Point
 Optimal 18 Point
 u • φ Γ ∞ ∪ ∩ θ ∈ [(symbol)

Prestigus Hoboken
Sebastian Rocky Oldr Englishr
Cartoon Script
 Channel 12 Point

\$19.95

LASERJET FONTS 2

Buck 24
Bongo 24 Bongo36

Chancellor Italic 10 12 14

Chancellor Bold 18 24

Chancellor Bold Bloody Italic

Chancellor Bold 30 40

Chancellor 50

Celestial 18 Celestial Bold 12

Celestial Italic 10 Celestial 8 10 12

Avant Reversed 22 Opus 28

Handwriting 16 rempuz 12

Windsor 24

Prolog Italic 10 Prolog 10 Prolog 7

Deco Plus 12 Deco Plus 14

IMPRESSED 12

→IN* ↔□IT□* →

Times Mutant Italic 12 Bold Italic 12

Times Repressed Bold 13

RUNIC 12 Coronet 18

Gaspice 36 Roadblock
WOOD PENCE

\$19.95 QUAD (\$31.95 DUAL DENSITY)

Computer games are what makes suffering through dBASE, Lotus and Word Perfect really worth it. We've assembled some of the best public domain PC based games in the following collections. Buy one of these disks and you'll get no useful work done for at least a week.

ALMOST FREE GAMES VOLUME 5

HACK is not so much a game as a culture. Originally written for the Unix operating system, this legendary game has endured for years and been added to by countless... extremely warped... minds. Plunge headlong into an infinitely complex labyrinth of rooms, passages and monsters. Never forget the monsters. Playable on any monitor.

KLONDIKE is a gorgeous implementation of Klondike solitaire in EGA graphics. Requires an EGA or VGA card, and a mouse is an asset.

NOID was originally written as a sort of playable advertisement for the Dominoes Pizza restaurants in the States. It's a tight little game none the less as you try to figure out how to deliver your pizza without getting stomped by the Noid, a rather nasty little creature in a red rabbit costume. It's fast, peculiar and challenging. Requires a CGA, EGA or VGA card.

MONOPOLY is a glorious EGA implementation of the classic board game... with a few cosmetic changes to avoid the wrath of Parker Brothers. Buy and sell property, advance to go, collect two hundred dollars and fuel the fires of international monetary inflation. Requires an EGA or VGA card, and a mouse is an asset.

MILLE BOURNE is a faithful graphics implementation of the classic French card game without the cards. Cruise around and avoid the road hazards. Requires an EGA or VGA card, and a mouse is an asset.

MAHJONG will take you back a few thousand years to those heady days when China was the centre of civilization and the ancients of most of the rest of us were still in the trees. If they'd had computers back then, they'd have played the game using this software. Requires an EGA or VGA card, and a mouse is an asset.

XTETRIS No one with a television set can have missed the ads for Tetris... makes you think that Nintendo invented the beast. Here's an expanded version of the classic falling block game having different shapes and a whole new set of strategies. Requires a CGA, EGA or VGA card.

SHOOTING This is one of the few shooting gallery programs to crop up which is really fun to blast away at. It features a variety of targets, allowing you to frag everything from clay pigeons to defenseless skeet. Requires a VGA card and a mouse.

CIPHER is a word puzzle. Figure out what the scrambled phrases mean using only your native wit and, in times of extreme stress, a mallet upside your monitor. Requires an EGA or VGA card and a mouse.

The Monopoly, Klondike solitaire, Mah Jong and Mille Bourne games are all the work of TEGS Systems Corporation of Vancouver. Programmers will be interested to note that both the source code for these programs and the sophisticated EGA user interface library upon which they're based are available from the author.

\$19.95 QUAD (\$31.95 DUAL)



AUTUMN (FRAGMENT) FROM COLOUR CLIP ART 12

ALMOST FREE GAMES VOLUME 4

SUSAN is a straight text adventure style game. The object of the game is to talk Susan into bed. Not exactly reluctant, Susan is not an easy date, either. This game contains adult situations, and should not be played by ruggies... who won't understand it anyway. If you plan to give this collection to the kids, we recommend that you delete this game.

PODWARS is a fast ASCII graphics game in which you get to cruise around levels of a space ship picking up things and killing other life forms. All that quest and slaughter is a lot of fun. Playable on any machine.

STAR GOOSE is a brilliantly conceived, gloriously executed graphics arcade game. It lets you fly a space ship over very weird alien terrain, blowing things up, flying into the jaws of death... literally... and picking up giant floating eyeballs. If the explanation is already leaving you behind, you really should play Star Goose and find out what it's all about. Requires an EGA or VGA card.

QUAD ALIENS is the strangest thing ever to infest a computer, and the mind which devised it was obviously pretty warped. The plot is all but indescribable... you get to wander around rooms that look like Luke Skywalker's worst nightmare, pushing things out of the way while you try to keep a reactor from going critical and blowing you to kingdom come. Even if you never work your way through it all... which is quite possible considering its complexity... Quad Aliens is worth it just to watch all the action. Requires a VGA card.

\$19.95

ALMOST FREE GAMES VOLUME 3

CAPTAIN COMIC is the best video game ever written for the PC, commercial or otherwise. Reminiscent of the Dark Castle graphic adventures for the Macintosh, it lets you guide your purple faced hero through a complex graphic world, picking up things, blasting monsters and ultimately finding the... well, we won't tell you what he finds. Requires an EGA or VGA card.

3-DEMON is three dimensional PacMan. Wander through corridors picking up food pellets and avoiding ghosts. Requires a CGA, EGA or VGA card.

QIX is an ASCII version of the arcade game. It's fast and runs on any card.

RACECAR is a brilliant ASCII game that lets you drive through a writhing, debris strewn course of death and disaster.

SEAHUNT is a computerized battleship game. It involves strategy, skill and a grasp of military tactics. You also have to like sinking ships.

\$19.95

ALMOST FREE GAMES VOLUME 2

BRICKS is a classic implementation of "Little Brick Out", which dates back to the personal computers. Kill bricks and relive a bit of history.

FLEES is a lightning fast, alien slaughter game... get the space fleas a'for they get you. Slaughter and green blood abound. Requires an EGA card.

PANGO is a rather strange little arcade game. You wander around kicking the hell out of bricks and squashing bees. It's fast and peculiar.

PIRATE is a huge graphic adventure game in which you wander through tunnels searching for buried treasure. The pictures are good, the plot is clever and gory, violent death awaits you. Fun for the whole family if they're a bit blood thirsty.

PITFALL pits you against the most dreaded space enemy of all... gravity. Pilot your ship down through the pit without getting mashed on the rocks.

RIBIT2 is the best public domain implementation of frogger we've encountered for a PC. Get your frog across the highway without having it run over.

ROUND42 is a peculiar little effort along the lines of space invaders. However, it's fast and evil, and will take you a long time to get the better of it.

STRIKER puts you in command of an attack 'copter flying into enemy territory. It's all done with pretty slick graphics, from the chopper itself to the missiles which will blow you into the next game room. Just like an arcade but it doesn't need quarters.

SUBCHASE is a graphic war game. You sail along dropping depth charges on unsuspecting subs. They frown on this sort of thing now, but it was very trendy in the early forties.

\$19.95

ALMOST FREE GAMES VOLUME 1

CARD is a simple draw poker game. You can shoot it if it cheats without having to worry about its cousins coming after you.

CASTLE remains one of the most engrossing public domain computer games. Wander around a nearly deserted castle collecting things and trying to get out.

CHESSII is a sophisticated chess game in which you can actually pick up and move the pieces. Features multiple look ahead levels. Requires a CGA, EGA or VGA card.



FLOWER POT (FRAGMENT) FROM CLIP ART 18

EGAROIDs is a stunning EGA asteroids game for EGA and VGA cards. Kill the rocks or suck vacuum.

FROGGER is a PC version of the classic arcade game. Get your frog across the road without making him into frog puree. Requires a CGA or EGA card.

HAUNT is a text based adventure game in which you can work your way through a haunted house with an endless array of rooms and objects.

LINKFOUR is a computerized version of the popular Connect Four vertical checkers game. Requires a CGA or EGA card.

PACKGAL is an ASCII based version of Pac-Man. Eat the punctuation and avoid the spectral characters.

PINBALL2 simulates a pinball game. This one has all the traditional flippers, out lanes, kickers and so on. Requires a CGA or EGA card.

TREK lets you tear through space meeting new and exciting life forms and slaughter them. It has lots of action and even a plot of sorts. Requires a CGA or EGA card.

WILLY is the strange saga of Willy the worm. In this episode you get to help Willy go home. Requires a CGA or EGA card.

\$19.95

Executive Series software has been designed with business users in mind. These disks contain no games, no programming utilities and no recreational software. They're stuffed to the last byte with productivity software, programs which will make your computer work harder and do more for you. If you use a PC and want to get the most out of it, you owe it to yourself to try Executive Series Software.

EXECUTIVE SERIES VOLUME 10

PC-AREA is the last word in telephone area code programs. Hit the alternate key of your choice and it pops up a window with all the provinces and states in North America.

FREEFORM is a data base manager for people who *don't* want to mess with dBASE. It creates a data base which is easy to use, requires no set up and can be keyed by a trained chimp.

STACK is a DOSEDIT replacement. It keeps a stack of your previous command lines.

CREDIT is a credit card manager, suitable for use in business or to keep track of your personal finances. It helps you refrain from spending yourself into oblivion. Requires Microsoft Windows.

VIEW2 is a file view program that lets you scroll through two files side by side.

DUSTY is the last word in Ventura Publisher style sheet utilities. It will create an exhaustive analysis of any style sheet.

RETPLAN is an RRSP and annuity planner and calculator.

\$19.95

EXECUTIVE SERIES VOLUME 9

ASCII is a great resident program for applications which require that you enter extended character codes into them. Just pop up this window and select them from a table. Great for word processing.

DRAFTC is like AutoCAD without the price tag. Requires a mouse.

TRICAL is the most sophisticated pop up calculator program yet devised.

CLIP allows you to extract sections of GIF files and make them into new, smaller GIF files.

FREEMEM is a dandy little Windows program which puts a window on your screen to tell you the current amount of free memory available to your applications. Requires Windows.

SUBMIT is an instant batch file. It allows you to run multiple commands at one time from the DOS prompt by separating them with colons.

TIME puts a digital clock into a Windows screen. Requires Windows.

TODDY adds a sophisticated command line editor to DOS to allow you to recall and edit previous commands. Saves buckets of typing.

\$19.95

EXECUTIVE SERIES VOLUME 8

ASEASY is a Lotus work-alike spreadsheet package. Featuring no copy protection, macros, pull down menus and more, it's the slickest piece of business shareware.

BAK will visit every subdirectory on your hard drive and automatically kill off all your BAK files.

BOOKMAKE uses an Epson compatible printer to format text so it looks like book pages.

IBM_SCRN is a character set for an Epson compatible printer which features all the high order graphics characters which you see on your screen.

JOT-IT is the slickest, most sophisticated resident note pad program yet written.

NOYB stands for "none of your business". It allows you to blank your screen whenever you leave the room. Once blanked, only you can restore it.

PCDC is a complete and extremely powerful database manager for handling flat file databases.

POSTGIF is our popular desktop publishing utility. It converts GIF files into halftoned clip art for use with Ventura, PageMaker, etc.

QCRT speeds up the screen updating for most systems quite noticeably.

SPEED also speeds up the screen of your system. This one has been fine tuned for EGA cards, however. Requires an EGA or VGA card.

SS is a spelling checker very similar in operation to the Webster's New World Spelling Checker.

THESAURUS helps you find better words to write with.

\$24.95 (TWO DISK SET)

EXECUTIVE SERIES VOLUME 7

DECEIVE is designed to save your job in the event that someone in authority pops in unexpectedly. Allows you to copy any screen from a business-like application and instantly pop it up over your video game, resume or other incriminating effort.

INVOICER is a complete inventory management, accounts receivable and invoice generator.

LM is the hottest label maker and mailing list management package we've encountered.

KDCG is an elegant calculator program. Runs from the DOS prompt. Requires an EGA or VGA card.

PHONES maintains a list of telephone numbers for you. Requires Microsoft Windows.

POPDBF is a pop up window which allows you to browse through any DBF file from within any application.

MINDREADER is a word processor for people who can't type. As you type, it uses artificial intelligence to guess what you'll type next.

ONEKEY is an elegantly simple keyboard macro program.

\$24.95 (TWO DISK SET)

EXECUTIVE SERIES VOLUME 6

INSTANT NETWORK Using a simple serial cable, this package will network any two PC's together.

LASER FONT EDITOR is a LaserJet laser printer soft font editor. Requires a Microsoft compatible mouse.

BS We won't tell you what "BS" stands for in this case, because we're sure you can work it out for yourself. Creates very meaningful sounding but very meaningless text.

FILE FINDER Faster and more flexible than Norton's FF utility, this program will find any file or group of files on your hard drive.

EGA RULER is for anyone who uses an EGA or VGA card. It will pop a text ruler over your work to help you line up spreadsheet columns, adjust your letters to fit your letterhead and so on.

WINDOWS FINDER is a Microsoft Windows application. Will locate files anywhere on your hard drive.

INTEREST CALCULATOR is a great little loan calculator. Given the principal, interest rate and payment size of a loan, it will print up a table to tell you how long your indenture will last.

INVENTORY should be on every computer on the planet. It helps you keep track of the contents of your home or office, providing you with a running count of the replacement cost of your assets.

JDOS allows you to pop a DOS command line up from within most any application... even if your application doesn't have a DOS SHELL facility.

NOTE is a browse program which runs as a pop up utility. Allows you to read any text file from within another application and it only ties up a few kilobytes when it's hiding in the background.

\$19.95

EXECUTIVE SERIES VOLUME 5

DERASE is the best file un-erase program we've encountered. It recovers most accidentally deleted files.

LETTERS 'N LABELS is a mailing list manager for moderate size mailing lists.

LASTRESORT gets you back to DOS, and usually allows you to save your files, when your computer hangs.

800K allows you to format normal dual density 360K floppies to hold eight hundred kilobytes in the high density drive of an AT.

WMF manages a portfolio of mutual funds... diligently. Allows you to edit and update your portfolio, print reports and even see detailed graphs.

MONEY WATCH is an elegantly simple money management program which is equally useful at home, for small businesses and for handling the finances of individual departments of larger businesses.

\$19.95

EXECUTIVE SERIES VOLUME 4

CALCQF Speed up your computer... possibly by several hundred percent... with no tricky hardware changes. Calculates how much of a speed increase you can realize and then sets up your machine to do it.

CONFMT allows you to format disks in the background while you're performing another task.

FM is a menu driven file manager. Copy, move, delete and generally meddle with your disk files, without typing commands.

FORMATQM formats lots of floppies very, very quickly, and is a worthwhile companion to CONFMT, above.

FINANCIAL PARTNER provides you with a variety of handy financial planning tools. Work out loans, annuities and other money matters with blinding ease.

HERCSAVE is for anyone using a Hercules compatible graphics card, blanks your screen after a set period of inactivity to avoid burning out your screen.

INSTACALC is a spreadsheet in a can. It's memory resident, and you can pop up a full blown spreadsheet program, complete with macros and all the trimmings, from within any application.

JETLAG helps you calculate how long you should be prepared to take it easy after a long international airplane journey.

MEMO will print memos with the word "MEMO" at the top in special effect characters. Requires a PostScript printer.

MURPHY helps keep your sanity by printing, from the AUTOEXEC file, a different clever thought every morning.

PINPRESS prints up to sixteen kilobytes of text on a page. Great for making archive copies of large documents. Requires an Epson FX-80 compatible printer.

POPDOS2 is a pop up utility which will handle your files and directories effortlessly from within any application.

QUIKCOPY is a replacement for the DOS DISKCOPY command. It duplicates disks in half the time or less, and makes multiple copies even quicker.

TED is the worlds smallest text editor. Use it for creating batch files, quick notes to yourself and other instant files.

ZAPDIR kills off subdirectories with one command... even if there's still something in 'em. Saves on manual deleting.

UNWS is a quick 'n nasty filter to turn WordStar files into text.

\$19.95

VENTURA SURVIVAL DISK

If you use the popular Ventura desktop publishing package, you'll probably be aware of a few of its... ahem... deficiencies. For example, you may have encountered the monumental difficulties involved in using it with additional soft fonts. Perhaps you've tried to pour image files into your documents and found them a bit awkward. What about the unspeakable boredom of having to use the same type faces over and over again... it's driven lesser mortals back to their typewriters.

As long time Ventura users ourselves, we've developed and collected quite an assortment of Ventura support programs. These things perform all sorts of useful functions, mostly connected with making Ventura a better place to live. Much of the software in this collection is specifically intended to make Ventura co-exist peacefully with a LaserJet compatible printer. If you publish with Ventura, you can't afford to be without this collection of programs.

FONTFILT is a splendid program for making boring fonts into exciting ones. It inhales any standard LaserJet soft font and outputs a font with your choice of special effects added to it, including drop shadows, bounding boxes and even dripping blood.

VFM manages your Ventura soft fonts. It quickly makes width tables without any batch files to contend with, allowing you to add fonts to Ventura painlessly. This is a must for any Ventura user.

GRAPHIC WORKSHOP is the last word in graphics programs. It views, converts, dithers, halftones and prints all popular image files. It works with MacPaint, GEM/Ventura IMG, PC Paintbrush PCX, GIF, TIFF and EPS files and drives CGA, Hercules, EGA, VGA, ATI VGA Wonder and Paradise cards. It's an indispensable tool for graphics in desktop publishing.

HP-SLASH will reduce the often times voluminous sizes of soft font files by allowing you to selectively "prune" out unused characters and symbols. Saves on hard drive space and really speeds up font downloading.

TCAP is a memory resident program which captures text screens as GEM/IMG graphics suitable for pouring into Ventura documents as pictures. These screens preserve the original screen attributes and can be scaled to any size from within Ventura.

GCAP captures monochrome graphics screens into GEM/IMG files, suitable for pouring into Ventura chapters. A Windows compatible version is also included.

FSEE is a quick 'n nasty program to let you view the contents of a soft font file on your screen before you print it. It lets you see what the new fonts will look like without your having to download them and print them out.

VPSCREEN is a Ventura screen font editor. It allows you to change the way fonts look on your screen.

\$19.95

DISK OF THE MONTH CLUB



If you enjoy Almost Free Software but never seem to get around to ordering it, we'd like to introduce you to our disk of the month club.

The disk of the month club provides you with a convenient way to get the best of public domain software and shareware, all without having to order it. Members of the club are sent each new disk automatically, roughly one disk every four weeks. Each disk is billed to a pre-authorized credit card number.

If you join the disk of the month club, you'll be able to review each new software collection at your convenience. If you receive a disk you don't want to keep, simply return it for immediate credit to your account.

For a limited time, if you sign up for our disk of the month club, we'll send you a bonus disk with your first order. Simply select any disk from this catalog and we'll include it free with your first monthly disk.

To sign up for the disk of the month club, please write, phone or FAX us. We'll need your Visa, MasterCard or American Express card number and expiry date. After that, all you'll have to do is enjoy your software.

Yes, I want to be part of the Almost Free Software disk of the month club. I hereby authorize Moorshead Publications to charge the credit card detailed below for each new disk as published. I understand that there will be approximately one disk per month and that I will be charged the advertised price, not to exceed \$25.00.

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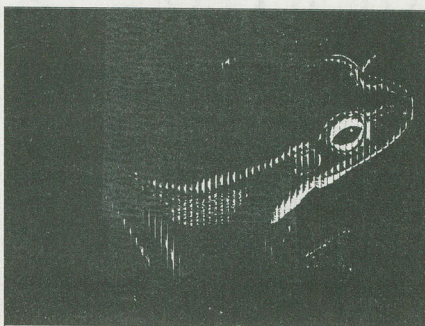
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ALMOST FREE SOFTWARE SAMPLER

NEW IN THIS CATALOG

If you aren't all that familiar with shareware — if this catalog's contents have sounded a lot like a politician's response to a question he didn't want to answer — or if you want to give someone new to computers a really interesting gift, may we suggest the Almost Free Software Sampler. Featuring an assortment of the most interesting shareware from various disks, this volume will introduce you to the true power of this low cost alternative to commercial software.

The Almost Free Sampler includes a user friendly unpacking program, about two megabytes of software and files and one genuine digital frog.



GRAPHIC WORKSHOP is a powerful graphics package which will allow you to really see what computer graphics can do. Complete with a variety of sample image files, it will provide you with tools to print pictures, convert them into various formats for inclusion in other programs and process them.

SPREADSHEET The biggest problem with commercial spreadsheet packages is that they cost hundreds of dollars per copy. This is a fully functional program which has most of the facilities of Lotus 1-2-3 without the price tag.

WORD PROCESSOR Here's a powerful word processing package based on a superset of the popular WordStar software. It's easy to learn, lightning fast and a perfect way to make the transition from typewriters to electronic text editing.

DATA BASE MANAGER Known as a "flat file" database, this program will allow you to set up large databases with a minimum of work. It lacks almost all the features of dBASE, meaning that you can make it work without having to take a three week course in dBASE programming.

DOS TOOLS We've also included over three hundred kilobytes of little DOS utilities, some of which you're certain to wonder how you lived without. The list actually goes on for several pages — it's a bit lengthy to get into in its entirety here. However, we're pretty certain that you'll find the answer to just about every question you've had about using DOS in these clever little programs.

CAPTAIN COMIC And finally, for those spare moments when you have the computer to yourself, we've included the finest computer game ever written; public domain or otherwise. Captain Comic has superb EGA graphics and a challenging plot which will take you ages to work your way through.

QUAD \$19.95 (DUAL \$31.95)

ALMOST FREE AUTOCAD VOLUME 2

FOR RELEASE TEN

Tired of typing long commands into AutoCAD? Having trouble dealing with the UCS and viewpoints? Do you get lost in Autodesk's own menu program? Here's a menu system that's easy to use and almost eliminates typing, as well as giving you macros that simplify working in 3D coordinate systems. It includes:

10 PULLDOWN MENUS All of the commands are available, plus custom macros.

SCREEN MENUS The sidebar choices change with the pull-downs. Icon Menus. See your hatching and font choices.

HELP WITH 3D UCS and Viewpoint macros.

275-COMMAND TABLET MENU For rapid picking (requires digitizer).

AN ELECTRONIC LIBRARY Component drawings and icons.

DOCUMENTATION All-ASCII docs and menus for ease of changing.

Please note: AutoCAD is a registered trademark of Autodesk Inc., who have no connection with this software. The Almost Free menu is not a stand-alone program, but must work in conjunction with Release 10 (any version, any monitor).

\$19.95

ALMOST FREE AUTOCAD VOLUME 1

This collection is a series of enhancements for users of the popular AutoCAD drafting package. These have been custom written by our in-house AutoCAD guru. Requires AutoCAD release 9.

PULL-DOWN MENU with over one hundred and fifty of the most often used commands, values and related variables grouped in logical order — almost eliminates searches and menu trees. Includes custom macros that call up a series of commands with a single pick.

CUSTOM ICON MENUS let you see your symbol library drawings or hatch patterns before you choose.

CUSTOM SCREEN MENU for rapid picking among your favorite commands or macros.

COMMAND TABLET MENU for rapid picking of commands and macros (requires digitizing tablet), plus a blank DWG and menu file for making your own. Includes 175 custom commands

ELECTRONIC SYMBOLS complete with icon menus for no-typing selection. Includes common analog and digital symbols for all types of schematic drawing.

PLUS: All the menus are ASCII files and can be easily changed with your word processor. Edit the commands just the way you want them, for your style of drawing. Includes complete documentation files with explanations of all the menu structures and macros and how you can change them.

\$19.95

Electronic clip art can turn a dull desktop publishing document into something visually exciting. Having a library of clip art on tap is tricky unless you own a scanner and a suitable source of paper clip art to start with. Almost Free Clip Art solves all this. Each one of our disks contains almost five hundred kilobytes of clip art - at least a dozen images per disk. These collections have been carefully chosen to each contain a variety of interesting pictures suitable for a wide range of applications. These pictures are suitable for use with virtually all applications which accept bitmapped art. This includes Ventura Publisher, Aldus PageMaker, Word Perfect 5 and PC Paintbrush. Each collection comes with a utility to convert the files into MacPaint, Ventura/GEM IMG, PCX and TIFF formats. All of these pictures are in the public domain. You can use them without any copyright restrictions.

PLEASE NOTE THAT SOME OF THE FILES ON THESE DISKS ARE NUDES, AND MAY NOT BE SUITABLE FOR YOUNG OR SENSITIVE USERS.

Costing no more than our regular clip art disks, these collections contain almost two megabytes of clip art each. Each is available on a single quad disk, or on multiple dual density disks for a slight extra charge. These files are provided in the PCX format, which can be used directly with PageMaker and Ventura Publisher. Each collection also includes a copy of Graphic Workshop, which will allow you to convert the files into virtually any other format you need them in.

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• BOMBAWAY • BURGULAR •
EASYPAY • EDDIE • FASTFOOD •
ALICE • BOOTS • KEYS • KIDSREAD •
LIE-READ • LILY • LOOKHERE • OPUS •
PAGE34 • PAGE36 • PAGE39 •
PAGE44 • PAGE45 • PAGE46 •
PAGE47 • PAGE48 • PAGE49 •
PAGE50 • PAGE51 • RKO-MIKE •
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**NEW
IN THIS
CATALOG**

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2NUDES • FACE2 • BUILDINGS-A •
BUILDINGS-B • NAGEL1 • NAGEL2 •
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CLIPTR-G • DROP-R • SCUBA • DINNER •
LADYTHINK • STARBURS • GOLF • HUNTER
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• CLIP-C • CLIP-A • PINGPONG • FAT-SUIT
• PAGE-21 • STARBURST-2 • BOWLING •
FISHING • HORSE • POOL • SKYDIVE •
TROPICAL-SCENE • SKI-LUNCH •
OLD-N-BALD • QUILLPEN • BIOMORF1 •
COMPUTER • PAGE03 • PAGE09 •
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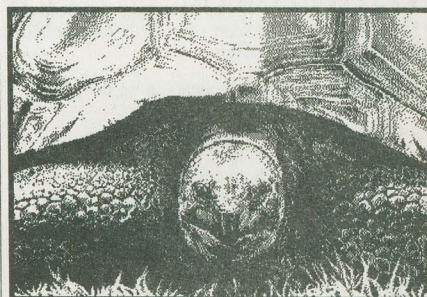
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These disks represent the state of the art in computer graphics, digitized full colour images which look like photographs. They can be viewed on any VGA compatible display card and the luminous quality of the images will leave you wondering how civilization existed before the advent of 24-bit colour.

PLEASE NOTE THAT SOME OF THE FILES ON THESE DISKS ARE NUDES, AND MAY NOT BE SUITABLE FOR YOUNG OR SENSITIVE USERS.

COLOUR CLIP ART VOLUME 12

**NEW
IN THIS
CATALOG**

SHANNON Is an intricately detailed scan of a girl's face at 1024 by 720 pixels.

ANNA appears to be sleeping.

AUTUMN Three warriors in the forest.

EGYPT not the whole country, of course.

CHESS All the queens aren't on the board.

CELLO A girl with music in her heart.

JENNY is wearing a hat.

SALLY is not.

WETGIRL in an equally wet bikini.

LIZARD is the ugliest damn thing.

FLAMINGO A grey scale scan of a bird.

BIRDOF Bird of Paradise, actually... a flower.

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COLOUR CLIP ART VOLUME 11

CASTLE A view of a medieval condo.

POPCAN A lifelike rendering of aluminum.

AKI A girl from the far East.

FOXY Two women on vacation.

ROOM A large ray-traced drawing of a room.

ESPRIT The Lotus Esprit Turbo... I'm saving up for one of these.

TIME A gold watch without retirement.

BOOTS You're never undressed so long as you keep your boots on.

BIKINI And occupant.

BLOND A natural blond.

JENNY Could be her real name.

LINDA And hers as well, but it's unlikely.

LION AND CUB Half ton of motherhood.

AOXOMOXOA A bit of a dead cover.

BLUE DENIM All natural fibers.

ALICE Looking pleased with herself.

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**NEW
IN THIS
CATALOG**

COLOUR CLIP ART VOLUME 10

BEHIND Looking out to sea on a sunny day.

MORE BOOTS Boots are very fashionable.

SWIM Three girls, none of whom are actually swimming.

JULIE It was a hot summer night...

YODA Extremely ancient Jedi.

PEACOCK A network logo from ages past.

COWGIRL Girl with ten gallon (37.8 liter) hat.

FERRARI A huge scan of a red Ferrari... for those who didn't like the Lotus Esprit.

LUSH Another huge scan, this one of a garden.

WALL A surrealistic wall, complete with moon.

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COLOUR CLIP ART VOLUME 9

LONDON is a grey scale picture of London seen across the Thames.

MBNIKE is a drawing of a sneaker.

MUSEUM takes you inside a museum... at an odd angle.

OPFACE is clearly the result of too much makeup or too much polysorbate-80.

PORSCHE is a car. How do you tell a Porsche from a porcupine?

SAILING Smell the salt, hear the thunder of the rigging, eat an albatross...

FANTASY These are seven magnificently scanned fantasy prints, each one a separate high resolution GIF file.

HAMMOCK is the largest GIF file we've encountered to date. A woman reclining in a hammock, it unpacks to almost half a megabyte of image data.

CRANES is a stunning picture of two birds.

NAOMI seems to be working out.

3WORLDS in which three planets explode outwards from the centre of the universe.

NAGEL Ten more sixteen colour GIF files of the poster art of Patrick Nagel.

\$24.95 (TWO QUAD DISKS)

COLOUR CLIP ART VOLUME 8

ALIEN is a thoughtful looking monster.

ESCHER 2 is a grey scale scan of Escher's "Ascending and Descending".

DOT First thing in the morning.

ESCHER 3 is another grey scale Escher scan, this one of "The Palace".

EYEBALLS two eyeballs... very strange.

LIGHTHOUSE You can almost hear the shriek of the gulls and smell the salt.

KARA Thoughtful looking girl beside the pool.

LOCKLEAR Head and shoulders shot.

SISTERS Two young ladies and a motorcycle.

NEBULAE Actually a fractal.

NAGEL This is a collection thirteen of Patrick Nagel's posters, each one a separate 640 by 350 pixel GIF file.

BRIGITT Red Sonya in a scene not part of the film.

TUTCHIP Circuitry and the boy king.

VEIL It's amazing how little these things hide.

AMANDA She seems to be dancing.

HEATHER Visibly surprised upon emerging from the shower.

CYCLE A 10-speed bicycle, expertly rendered.

MISSY Girl with long hair.

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If you own a system with a VGA card, you owe it to yourself to own some of these incredible files. A simple viewing program is included with each disk, and a more powerful image viewing system is available on our GIF User's Toolkit disk, available separately for \$24.95. Desktop publishing users will find these files particularly interesting, as they can be halftoned or dithered into superb black and white clip art. They can be used with Ventura, PageMaker, WordPerfect and most high end desktop publishing word processing packages.

COLOUR CLIP ART VOLUME 7

- IRELAND** Or a very small part of it.
BARTON A landscape... motel art come to life.
TORNJNS The effects of wear on Levis.
EXCALID A woman and her motorcar.
LEOPARD A big cat.
OCEAN After bathing at Baxters...
HELMET Two of them and some aircraft.
BICYCLE Woman on bicycle.
AWAKE Looks like about one in the afternoon.
LENSMIRR A stunning bit of ray tracing.
TIGER1 Another large cat.
BRANDI Almost certainly not her name.
PILLOW A girl and her pillow.
LUNA The moon as seen from space.
CLOWN Large nose and excessive makeup.

\$24.95 (TWO QUAD DISKS)

COLOUR CLIP ART VOLUME 6

- HUMMINGBIRD** near some flowers.
MARGIE A girl with unusual makeup.
MBDUFFEK Woman reclining.
ASTRONAUT floating above the earth.
SILK Do silkworms really know what they're up to.
PIGS Bacon on the hoof,
PAULINA Head and shoulders.
ALISON Probably not her real name.
MOLISA The girl to excite your computer.
VGADNA Part of the double helix.
APPLE A hand painted apple.
RUBENS Two impressionist GIF files.
FANTASIA Mickey Mouse and special effects.
BEAUTY Conceptual art.
WALRUS A walrus on a rock, singing.
THINKING Something on her mind.
GILDA2 Probably also not her real name.
HENGE Stonehenge at dawn.

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COLOUR CLIP ART VOLUME 5

- LILIES** Impressively detailed scan of tiger lilies.
BUDGIRLS women on a Budweiser ad.
CRAYBALL is a ray traced picture.

- WETSHIRT** is a girl in a wet T-shirt.
LOVERS is a fantasy painting of two lovers.
STRIPE is a woman in striped pants.
AMDEK is a beautiful watercolour.
COLOURS is a picture of desert.
CHERIE is a woman in furs.
CABLE3 is a girl named Cable relaxing
PBEAR is a polar bear and her cub.
CABLE4 in which Cable works out.
KIWI is a snack tray.

\$24.95 (TWO QUAD DISKS)

COLOUR CLIP ART VOLUME 4

- APPLES** Two apples... the eating kind, not the litigating kind.
BIRDEYES Abstract bird.
CABLE The second most breathtaking nude GIF file we've encountered of late.
CATFRAME A cat.
DANCERS A victorian print of dancers.
FIRE The first most breathtaking nude GIF file we've encountered of late.
FROGG A really weird looking frog.
GOYA A classical nude GIF file.
LADYHAT A lady in a hat.
PAULINAO A girl with her clothes on.
ROCKER An abstract of a rocker.
ROOTSV Pythonesque trees.
ROPE Some ropes on a ship.
ROSE A close up of a flower.
SKYLINE A still life.
SUNSET Another still life.
SWORD Warrior maiden in repose.

\$19.95 QUAD (DUAL DENSITY \$31.95)

COLOUR CLIP ART VOLUME 3

- ANGELA** A girl named Angela.
APR89 Woman and machete.
TECH Chrome plated woman.
BALLOON A hot air balloon.
BOUQUET Flowers.
COMDISK A compact disk .
DRHOUS A dream house.
EYE Close up of an eye.
FISH Just before the cat got'em..
JILL Jack's sister.

- LEGEND** A fantasy scene.
MICKEY Fifty year old mouse.
PANDA Art deco bear.
TAROT Two cards.
TENSPEED A bicycle.
WAVES The ocean revisited.
GODDESS Home perm aftermath.
LOVERS Two people and a fireplace.

\$19.95 QUAD (DUAL DENSITY \$31.95)

ALMOST FREE GIF USERS KIT

The incredible popularity of our GIF file colour clip art collections has prompted us to assemble this toolkit of programs for people who buy our GIF disks. It contains more and better programs than we've been able to include on the GIF disks themselves due to space constraints.

If you've bought one of our GIF collections, please check out this disk. It will make your GIF files a lot more interesting and quite likely a lot more useful as well.

This collection comes on two dual density floppies. It also includes several sample GIF files.

GRAPHIC WORKSHOP is the last word in graphics programs. It views, converts, dithers, half-tones, reverses and prints all popular image files. It works with MacPaint, WordPerfect WPG, GEM/Ventura IMG, PC Paintbrush PCX, GIF, TIFF and EPS files and drives CGA, Hercules, EGA, VGA, ATI VGA Wonder, Headland Video 7 and Paradise cards.

CROP GIF allows you to crop smaller fragments out of your GIF files. Use graphic Workshop, above, to convert other formats into GIF files for cropping. This program uses a simple mouse interface to make cropping image fragments no more complicated than using a paint program Requires a Microsoft compatible mouse.

GRAFCAT Prints up a visual catalog of your image files to either a PostScript or LaserJet Plus compatible laser printer. Each page will contain sixteen images. GRAFCAT accepts any mixture of IMG, MacPaint, PCX and, of course, GIF files. The GIF images are dithered to black and white for easier viewing.

VGACAD is a public domain GIF paint program. It allows you to edit and even create your own two hundred and fifty-six colour GIF files. This is a first class package, and a lot of fun. Requires a mouse and a VGA card.

CSHOW is the best GIF file viewer yet written, and this is the latest version of this powerful package. It features panning over large files, a directory selection menu, loadable support for super VGA modes, colour palette adjustment and all the bells and whistles you could ask for.

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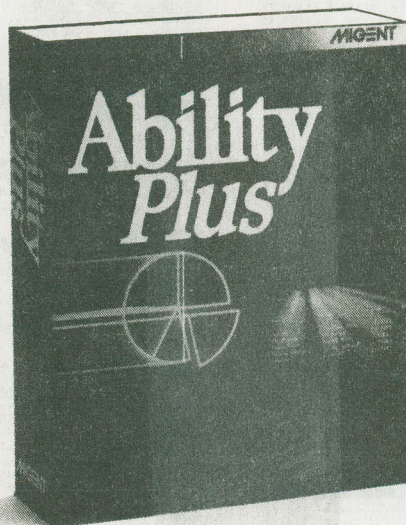
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Understanding the 567 Tone Decoder

Donald Wilcher

Synchronization of the horizontal and vertical sweep in television receivers and transmitted sync pulses were the first wide-spread uses of phase-locked loops back in the 1940s. Such circuits carried the names "Synchro-Lock" and "Synchro-Guide." Since that time, the phase-locked loop is an extremely versatile circuit that is used for frequency comparison and synchronization, frequency multiplication and division, frequency-to-voltage conversion (FM demodulation), frequency shifting and AM demodulation. The basic phase-locked loop circuit consists of an analog multiplier, a low-pass filter, and a voltage controlled oscillator. The ability to insert various components into the feedback loop before or after the VCO gives it the versatility of a variety of circuit applications as previously mentioned. The phase-locked loop circuit that is quite versatile in terms of circuit applications is the 567 Tone Decoder IC. This phase-locked loop circuit is capable of responding to a specific tone of a constant input frequency within its bandwidth. Basically, the 567 is a circuit capable of detecting a frequency that is equal to its free running or center frequency and locking on to that frequency.

In the following paragraphs the design, construction and circuit applications will be explored. At the end

of the discussion, an experiment will be described in a step-by-step procedure so that the theory can best be comprehended by the reader through the use of hands-on experimentation.

Chip Construction and Configuration

As mentioned in the introduction, the 567 device is a phase-locked loop system designed specifically to respond to a given tone of constant input frequency within its bandwidth. The bandwidth is a percentage of the constant input frequency and is expressed in a mathematical equation which will be defined later. The 567 phase-locked loop chip contains a phase detector, two driver amplifiers, a quadrature phase detector, and a current controlled oscillator. Upon the IC detecting an input signal, if the signal level at the lock frequency is sufficiently high, the driver amplifier turns on providing load drive capability up to 200 mA. When an "inband" tone is present above the required minimum level, the 567 chip will provide an output whose voltage level depends upon the circuit supply voltage. The output signal is provided by an uncommitted transistor incorporated into the driver amplifier (pin 8) of the IC. When the transistor saturates due to an inband signal present at pin 3, its collector voltage is less than 1 volt (typically 0.6 volts) providing an output drive capability up to 200 mA. Figure 1. illustrates the block diagram of the 567 Tone Decoder phase-locked loop IC.

Resistor R_1 should be between $2K\Omega$ and $20K\Omega$ for best temperature stability. The capacitor C_2 is the low-pass element for the chip. Capacitor C_3 value is generally non-critical because it sets the band edge of the low-pass filter portion of the chip. Besides setting the band edge of the low-pass filter, the C_3 capacitor attenuates frequencies outside the detection band to eliminate spurious outputs. If C_3 is too small, frequencies just outside the detection band will switch the output stage on and off at the beat frequency or the output may pulse on and off during the turn on transient. If C_3 is too large in value, turn on and turn off of the output stage will be delayed until the voltage on C_3 passes the threshold voltage.

Design Equations and Limitations

The following equations are used in identifying design parameters which dictate the circuit performance of the 567 PLL IC.

Center Frequency is approximately equal to:

$$f_0 \approx 1.1 / R_1 C_1$$

where R_1 should be between $2k\Omega$ and $20K\Omega$.

$$C_2 = V_{in} / (1070/BW)^2 \text{ in } \mu F.$$

where $v_{in} \approx 100 \text{ MV}$. (input Volts V_{in})

BW (Bandwidth) is approximately equal to:

$BW \approx 1070 \text{ SQR}(V_{in} / f_0 C_2)$ in which BW is a % of f_0 . Note: SQR means square root.

Design Example:

Design a Guitar Tuning Aid to decode an 82.4 Hz ("E" note) using a 567 Tone Decoder Chip. Input signal level is 100mV.

Solution:

Picking C_1 to be 4.7 μF , R_1 equals:

$$R_1 = 1.1 / f_0 C_1$$

$$= 1.1 / (82.4 \times 4.7 \mu\text{F})$$

$$= 2.8 \text{K}\Omega, \text{ use a } 2.7 \text{K}\Omega \text{ resistor.}$$

$$C_2 = (V_{in} / f_0) \times (1070 / 12\%)^2$$

$$= (100 \text{ mV} / 82.4 \text{ Hz}) \times (1070 / 12\%)^2$$

$$= 9.65 \mu\text{F}, \text{ use a } 10 \mu\text{F} \text{ capacitor.}$$

C_3 equals $2 \times C_2$ which equals:

$$2 \times 9.65 = 19.3 \mu\text{F}, \text{ use a } 22 \mu\text{F} \text{ capacitor.}$$

Figure 2 is the completed circuit for a Guitar Tuning Aid.

Design Limitations

As discussed previously, the value of R_1 should be between $2 \text{K}\Omega$ and $20 \text{K}\Omega$ for best temperature stability. The 567 IC has an input decoding range of 0.1 Hz through 500KHz. The value of C_3 shouldn't be too small or too large where the output will not switch on and off at the beat frequency or the output switching will be delayed until the voltage on C_3 passes the threshold voltage respectively. Due to the high switching speeds (20nS) associated with the 567 operation, care should be taken in lead routing. Lead lengths should be kept to a minimum. Another factor which must be considered is the effect of load energization on the power supply. For example, an incandescent lamp or dc motor typically draws 10 times the rated current at turn on. This can cause supply voltage fluctuations which could, for example, shift the detection band of narrow band systems sufficiently to cause momentary loss of lock. The result is a low frequency oscillation into and out of lock. Such effects can be prevented by supplying heavy load currents from a separate supply.

Applications

Although there are numerous applications in which the 567 Tone Decoder IC can be used, the two most popular ones are a Tone Decoder and a Frequency Indicator.

The Touch Tone™ application of the 567 is used for decoding Dual Tone, Multiple Frequency (DTMF) signals. These DTMF or Touch Tone signals are coded in tone pairs using two of seven possible tones or numbers 0 through 9, and the symbols # (pound) and * (star). The listing in Table 1 shows the audio frequencies used in the system. The basic decoder circuit for a single digit or symbol is shown in Figure 3. Note in the circuit that two 567 decoders are needed to represent the number 9. A low tone of 852 Hz and a high tone of 1477 Hz are required for correct tone detection. When the Touch Tone signal corresponding to the number is detected at the input of the circuit, the output of both decoders will be at logic 0 signifying both PLLs are locked. The output of the NOR Gate will be at logic 1. If the NOR Gate's output is at logic 0, this represents the number 9 input was initiated by the user. If you have not already guessed it, this circuit describes how a Touch Tone telephone keypad functions. To create a partial telephone keypad, a circuit consisting of 12 NOR Gates and 7 PLLs would be required. Figure 4 illustrates such a system.

The construction of a low cost frequency indicator is a novel application for the 567 IC shown in Figure 5. The decoder labelled (A) is set approximately 6% above the desired frequency, while the other decoder labelled (B) is set 6% below. If the input frequency is within 13% of the desired frequency, either lamp No. 1 or lamp No. 2 will come on. If both are on, then the frequency is within 1% of the desired frequency.

A Demonstration of the 567 Circuit Operation Through Experimentation

Objective

The objective of this experiment is to demonstrate the operation of the 567 phase-locked loop Tone Decoder IC.

1. Wire the circuit shown in the schematic diagram of Figure 6. Apply power to the circuit and adjust the frequency generator for 60Hz output signal with a 2 volt peak-to-peak signal level. The LED should not be lit at this time.
2. Slowly decrease the input frequency until the LED lights, and record this frequency:
 $f_1 = \underline{\hspace{2cm}} \text{ Hz}$
3. Slowly continue to increase the input frequency until the LED goes out and record this frequency:
 $f_2 = \underline{\hspace{2cm}} \text{ Hz}$
4. Set the input frequency at about 40 Hz. Slowly increase the input frequency until the LED lights and record this frequency:
 $f_3 = \underline{\hspace{2cm}} \text{ Hz}$
5. Slowly decrease the input frequency until the LED goes out and record this frequency:
 $f_4 = \underline{\hspace{2cm}} \text{ Hz}$
6. Now set the input frequency at approximately 40Hz and measure the frequency at pin 5 of the 567 integrated circuit, which is the vco free running frequency, f_0 . Record your result:
 $f_0 = \underline{\hspace{2cm}} \text{ Hz}$

From the measurements of Steps 2 through 6, you have determined the range of frequencies for which the 567 tone decoder will lock. Decreasing frequencies will occur at f_1 and will stay locked until the input frequency reaches f_2 . On increasing frequencies, lock will occur at f_3 and will stay locked until the input frequency equals f_4 . The free running frequency f_0 is determined by the $18 \text{K}\Omega$ resistor (R_1) and the $1 \mu\text{F}$ capacitor (C_1) according to the approximate equation: $f_0 \approx 1.1 / R_1 C_1$ which is about 61 Hz. Within 10%, this should agree with the values just determined. The % bandwidth is found from: % bandwidth $(BW) = (f_2 - f_4 / f_0) \times 100$.

From your results, compute the % bandwidth and record your result:

$$\% BW = \underline{\hspace{2cm}}$$

For the 567 Tone Decoder, the % BW is typically 14%. The frequency range, $f_2 - f_4$ is the lock range of the decoder phase-locked loop, and is sometimes referred to as the bandwidth. The fre-

quency range, $f_3 - f_1$ is the loop capture range and is never greater than the lock range.

7. From the values you determined in Steps 3, 4, and 5, compute the lock range ($f_2 - f_4$) and the capture range ($f_3 - f_1$) for this 567 Tone Decoder circuit and record your results:

lock range = _____

Hz, capture range = _____ hz

GLOSSARY of TERMS

Center Frequency (f_0) - The free running frequency of the current controlled oscillator (CCO) in the absence of an input signal.

Detection Bandwidth (BW) - The frequency range, centered about f_0 , within which an input signal above the threshold voltage (typically 20mV rms) will cause a logical zero state on the output. The detection bandwidth corresponds to the loop capture range.

Largest Detection Bandwidth - The largest frequency range within which an input signal above the threshold voltage will cause a logical zero state on the output. The maximum detection bandwidth corresponds to the loop lock range.

Detection Bandskew - A measure of how well the largest detection band is centered about center frequency, f_0 . The skew is defined as the $(f_{\max} + f_{\min} - 0) / f_0$ where f_{\max} and f_{\min} are the frequencies corresponding to the edges of the detection band. The skew can be to zero if necessary by means of an optional adjustment. □

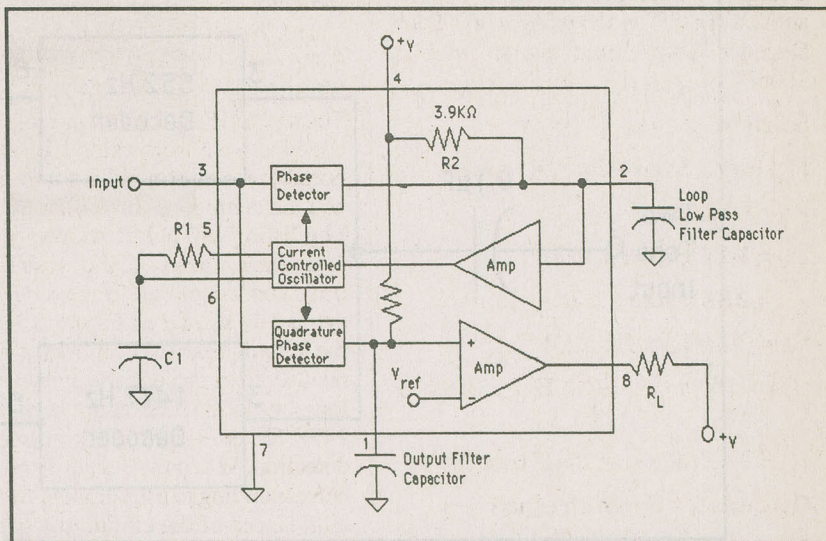


Figure 1.
Block Diagram Of The 567 Tone Decoder Phase Locked Loop

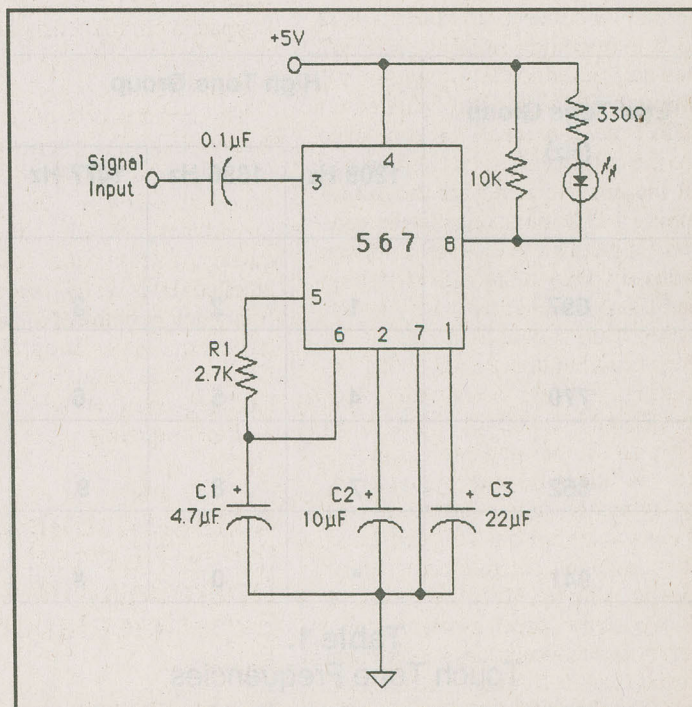


Figure 2.
An Electronic Guitar Tuning Aid Using The 567

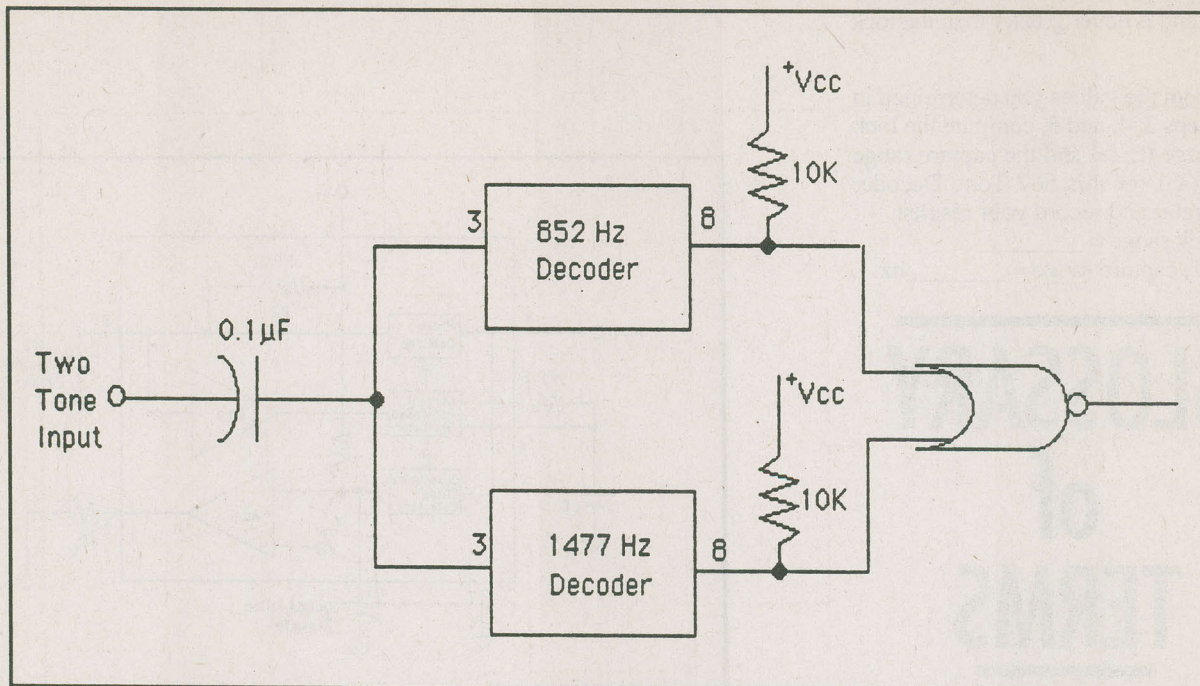


Figure 3.
Touch-Tone Decoder For The Number 9

Low Tone Group (Hz)	High Tone Group		
	1209 Hz	1336 Hz	1477 Hz
697	1	2	3
770	4	5	6
852	7	8	9
941	*	0	#

Table 1.
Touch Tone Frequencies

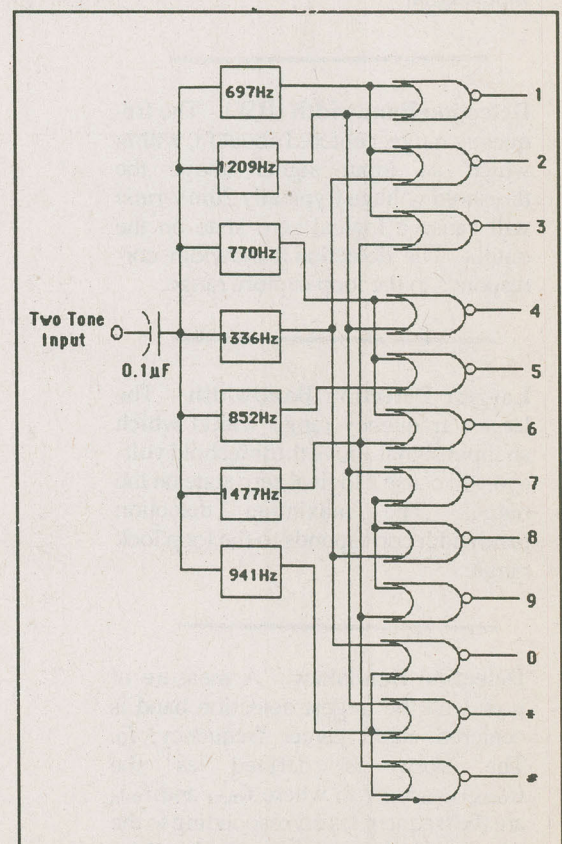


Figure 4.
A 12 Digit Touch-Tone Decoder Circuit

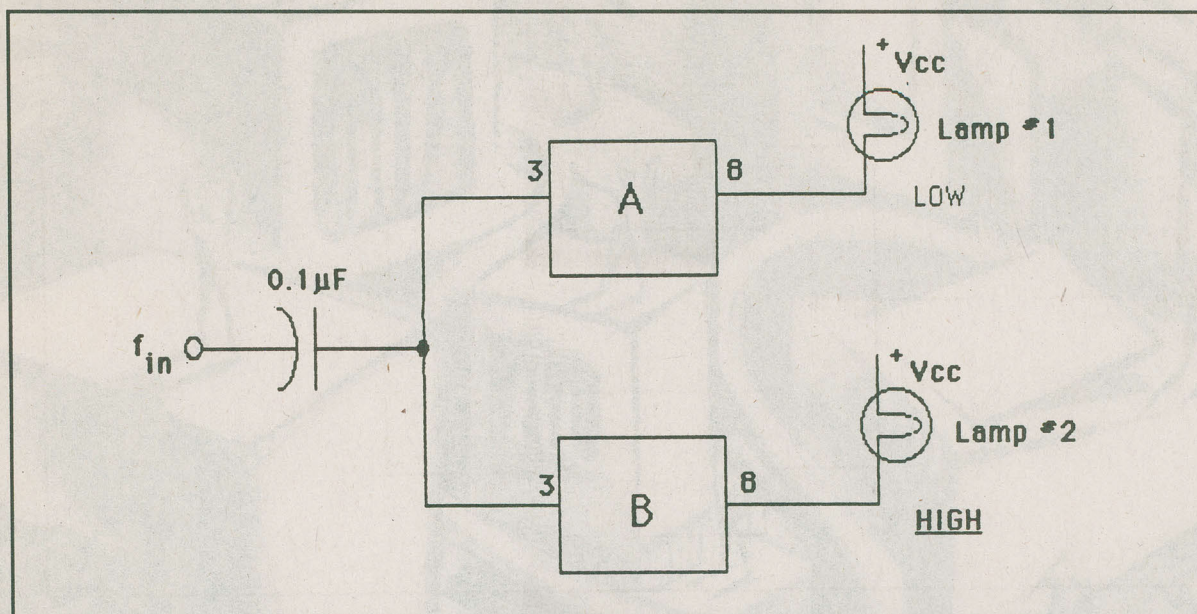


Figure 5.
A Simple Frequency Indicator

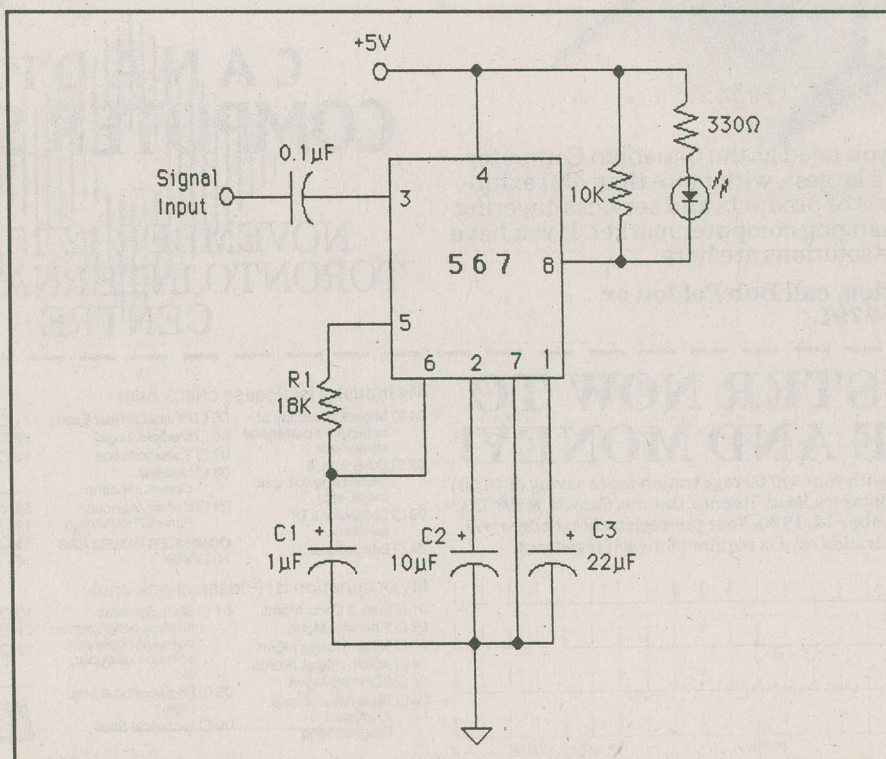
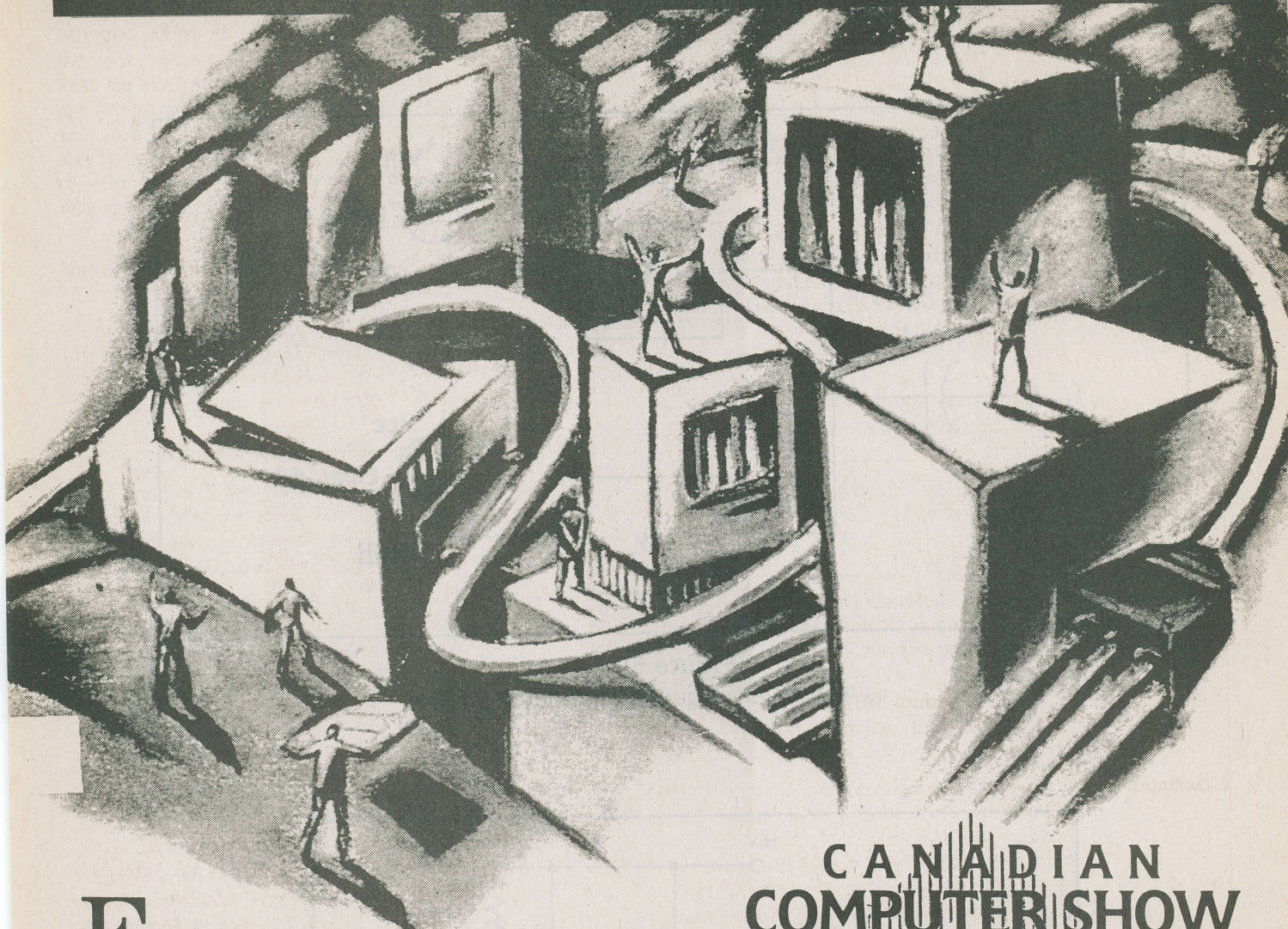


Figure 6.
A 567 Phase-Locked Loop Tone Decoder

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| | 10 <input type="checkbox"/> VAR | |

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Event: Third Annual Radar Symposium

Description: The Communications Research Laboratory (CRL) has been actively engaged in radar research since its inception in 1971 and has grown to become a leading centre of radar expertise. In late 1987, the CRL became a founding member of the Telecommunications Research Institute of Ontario (TRIO) and now fosters most of TRIO's radar research. In 1988, to provide a Canadian forum for the exchange of information and results in radar research, the CRL, in collaboration with TRIO, established the annual CRL Radar Symposium of which this is the third. This year's theme is "Radar in the 21st Century" and the program of thirteen papers offers a perspective on radar research and development activities in Canadian industry and universities.

Date & Place: October 1, 1990, Albion Room, Hamilton Convention Centre, 115 King St. W., Hamilton, Ontario

Contact: Anne Myers, Communications Research Laboratory, McMaster University, 1280 Main St. W., Hamilton, Ontario L8S 4K1 Tel: (416) 525-9140 extension 4085 Fax: (416) 521-2922

Event: IICIT Symposium '90, 23rd Annual Connector and Interconnection Technology Symposium

Description: IICIT (International Institute of Connector and Interconnection Technology) Inc., is pleased to present its first international symposium. The program meets the ever-changing and growing needs of those in the connector and interconnection industry. In addition to twelve technical sessions which enable you to hear original papers presented by their authors, this 23rd Symposium includes exhibits, forums and the opportunity to enrol in six different tutorials. Seventy-five companies will be presenting the latest products and services available in the industry. For the first time, a course in Basic Technology will be offered.

Date & Place: October 8-11, 1990, Harbour Castle Westin Hotel, Toronto, Ontario

Contact: IICIT Tel: (708) 940-8800

Event: REHABEX '90

Description: REHABEX '90 is Canada's first rehabilitation trade show and conference for health care professionals. Jocelyn Lovell, former three-time Olympic cyclist and spokesperson for the Spinal Cord Society (SCS) Canada will be appearing at REHABEX '90. Lovell, a quadriplegic since a cycling accident in 1983, says the REHABEX show presents a great opportunity for the Society and rehabilitation in general. "This is a chance to increase awareness

of what should be done for people with disabilities. The Spinal Cord Society, which was founded in 1978, advocates a 'cure not care' approach to spinal cord injuries. For far too long, the approach has been the reverse. As a member of the Spinal Cord Society, I believe in the literal definition of rehabilitation—to restore to original condition. In bringing care to those with disabilities, the logical goal is cure."

Date & Place: October 10 and 11, 1990 at the Metro Toronto Convention Centre

Contact: Janet Halenda, ECM, 1599 Hurontario St., Suite 301, Mississauga, Ontario L5G 3H7 Tel: (416) 274-5505 or Media Plus at (416) 568-3777 Fax (416) 274-0060

Event: Computer Fest '90—Fall Show

Description: This consumer show has all leading micro brands available. It includes software demonstrations, door prizes and hourly draws. A panel of experts will be dispensing free advice

Date & Place: October 12 - 14, Arts, Crafts and Hobbies Bldg. at Exhibition Place, Toronto, Ontario, Hours, Noon to 9, 10 to 6, 10 to 6. Admission is \$6.00 at door, attendance 15,000.

Contact: David Carter, Showfest Productions (416) 925-4533

Event: Vardex Toronto '90

Description: Vardex is Canada's only reseller-oriented computer show. Show attendees are: VARs, VADs, OEMs, consultants and system integrators. Exhibitors are manufacturers and distributors, who are actively looking for resellers. Seminars include: timely issues such as the GST, Free Trade and other changes to the VAR business world.

Date & Place: October 17, 10 am - 8 pm and October 18, 10 am - 6 pm, 1990, Admission: \$20 for exhibits, seminars are \$36 for CADAPSO/Software Ontario member, non-members pay \$45. Attendance 3,000.

Contact: Reed-MacGregor Exhibitions Inc., 800 Denison St., Unit 7, Markham, Ontario L3R 5M9, Tel: (416) 479-3939 Fax: (416) 479-5144

Event: The Canadian High Technology Show

Description: The Canadian High Technology Show is designed to benefit electronics professionals of every discipline. The seminar series is directed at helping these professionals succeed in the 90's. Global competition, economic pressures and new technology are rapidly transforming the high technology industry and the careers of those who work within it. Ongoing education for electronics professionals is essential.

Date & Place: October 23, 9:30 am - 5 pm and October 24, 9:30 am - 5 pm at Exhibition Place in Toronto. Registration at the door is \$10.00.

Contact: Ron Connelly, (613) 731-9850 / Dan Hamilton, (613) 731-9850

Event: MacWorld Expo

Description: This show is an opportunity for Canadian developers and distributors to raise their profile in the Canadian market and meet key user and vendor contacts from the US and overseas.

Date & Place: October 23 - 25, Better Living Centre and Queen Elizabeth Theatre, Exhibition Place, Toronto, Ontario; Hours 10-6, 10-6, 10-3; Admission: \$15 in advance, \$25 at the door for exhibits, \$75 in advance, \$90 at door for conference; Attendance: 20,000

Contact: (416) 742-9607

Event: Canadian Computer Show

Description: This show is an exhibition of the latest in computers, software, communications products and related services on the North American market.

Date & Place: November 12 - 15, 1990; International Centre, Mississauga, Ontario; Hours: 10-6; Admission: \$10 pre-register, \$15 at the door; Attendance: 30,000.

Contact: (416) 252-7791

Event: Electronic Design Show

Description: This show will feature manufacturers, distributors and service companies of computers, software, copiers, computer graphics, and image manipulation, electronic imaging, desktop publishing and desktop video products. It will be held in concert with VICOM '91.

Date & Place: April 11 - 13, 1991; Toronto Convention Centre; Hours: 11-9, 11-6, 11-5; Admission: \$10 at door; Attendance: 8,000

Contact: Jai Cole (416) 660-2491

Event: VICOM '91

Description: This show is of interest to visual communication specialists, such as photographers, graphic designers, multimedia specialists, advertising and marketing personnel and TV and film producers.

Date & Place: April 11 - 13, 1991; Toronto Convention Centre; Hours: 11-9, 11-6, 11-5; Admission: \$10 at door; Attendance: 8,000

Contact: Jai Cole (416) 660-2491

Event: Intellect, International Electrical Conference & Exhibition

Description: This is Canada's first international, multi-faceted Electrical Conference and show for senior specifiers and buyers of electrical equipment. Technical and business conferences will offer the latest in technological developments and practices. Major electrical manufacturers and suppliers will have the experts on hand to demonstrate all aspects of electrical products and services.

Date & Place: June 10, 11, & 12, 1991, Metro Toronto Convention Centre, Toronto, Ontario

Contact: Kerrwil Show & Conference Group, 395 Matheson Blvd., East, Mississauga, Ontario L4Z 2H2 Tel: (416) 890-1846 Fax: (416) 890-5769

Event: INTEROP 90

Description: A record of 200 exhibitors are expected to demonstrate interoperable products based upon TCP/IP, GOSIP/OSI, the X Window System and other Open Systems technologies. All major computer and communications vendors are represented at INTEROP 90.

Date & Place: October 8 - 12, 1990, San Jose Convention Center, San Jose, California

Contact: Interop, Inc. 480 San Antonio Road, Suite 100, Mountain View CA 94040 Tel: (415) 941-3399 Ext. 639 Fax: (415) 949-1779

Event: Info '90

Description: Today's computer environment is changing at a breakneck pace. The competition for new standards is fiercer than ever, as manufacturers and software developers struggle to communicate the benefits of their products to you. Info '90 puts you face to face with the industry's leading figures and consultants—so you can successfully come to grips with issues that affect your bottom line. You'll learn about the most up-to-date connectivity solutions, platform issues and operating systems, as well as how to get the most from your current equipment.

Date & Place: October 10 - 12, 1990, Jacob K. Javits Convention Center, New York, New York

Contact: Info '90, P.O. Box 7069, North Suburban, IL 60199-7069

Event: Imaging '90

Description: The Shape of tomorrow's imaging market can be seen at Imaging '90. The Imaging '90 Conference and Exposition provides vendors and users alike with the industry's most unique and focused forum to explore the state-of-the-art image management systems for paper-intensive industries and image-intensive operations. For three days, dozens of exhibits, conference sessions and workshops offer you the most comprehensive opportunity to explore solutions,

- work with vendors, share experiences, and learn from the industry's pioneers.
- Date & Place:** October 10-12, 1990, Jacob K. Javits Convention Center, New York, NY
- Contact:** Imaging '90 Box 7069, North Suburban, IL 60199-7069 Tel: (203) 964-8287
- Event:** Ninth Annual Print Quality Seminar
- Description:** BIS CAP International's Print Quality Seminar has a ten year history of being the only industry forum devoted to the in-depth exploration of technical print quality issues and the market impact of these issues. This intensive program is a cost-effective two-day investment for you and other managers and professionals in Research and Development, Engineering, Product Development and Marketing.
- Date & Place:** October 10 - 12, 1990, Boston Marriot Cambridge, Boston, MA
- Contact:** BIS CAP International, P.O. Box 68, Newtonville, MA 02160 Tel: (617) 893-9130 Fax: (617) 894-5093
- Event:** Cleaning Technology Forum '90
- Description:** Comprehensive discussion of the options available for PC Board Cleaning
- Date & Place:** October 24 & 25, 1990, Sheraton Centre Park Hotel, 1500 Stadium Drive East, Arlington Texas 76011
- Contact:** Juli Spoonemore, Electrovert USA Corp., 4330 Beltway Place, Suite 340, Arlington, Texas 76018 Tel: (817) 468-5171 Fax: (817) 468-1959
- Event:** Conference on Managing Factory Floor Graphics and Software Systems
- Description:** Co-sponsored by NCGA and the Automation Forum and held in conjunction with the sixth annual meeting of the Automation Forum, this event will feature a tour and case study of the Coming Asahi Video plant, applications-oriented conference sessions and the Automation Forum's second annual Renewal Award presentation.
- Date & Place:** October 29 - 31, 1990, Toftress Hotel, Resort and Conference Center and Coming Asahi Video Products Company, State College, Pennsylvania
- Contact:** National Computer Graphics Association, 2722 Merrilee Drive, Suite 200, Fairfax, Virginia 22031 Tel: (703) 698-9600 Fax: (703) 560-2752
- Event:** Seventh Annual Electronic Imaging East Exposition and Conference

- Description:** This four-day conference and exhibition sponsored by BIS CAP International and Miller Freeman Expositions is the one forum for technology integrators, OEMs and end users to see and learn about the latest imaging tools and how to use them in their products and applications. This year's conference program visually links instructional information with the real-world, hands-on applications of the exhibit floor.
- Date & Place:** October 29 - November 1, 1990, The Hynes Convention Center in Boston, MA
- Contact:** BIS CAP International, 1 Longwater Circle, Norwell MA 02061 Tel: (617) 982-9500 Fax: (617) 878-6550
- Event:** COMDEX/Fall '90
- Description:** Bill Gates, the chairman, chief executive officer and co-founder of Microsoft Corporation, will deliver the Keynote Address, "Information at Your Fingertips," at COMDEX/Fall '90 in Las Vegas. Gates will speak at 9:30 am on Monday, November 12, in the Las Vegas Hilton Showroom to start the 12th annual COMDEX/Fall, the largest annual trade show in the U.S. Over 1,800 companies will exhibit, promote and demonstrate computers and computer-related products, programs and services on over 2.1 million square feet of show floor at 10 sites throughout Las Vegas.
- Date & Place:** November 12 - 16, 1990; Sands Expo and Convention Center, Las Vegas Convention Center and West Hall, Bally's Casino Resort, Caesars Palace, Cashman Field Center, Las Vegas Hilton Riviera Hotel, Sahara Hotel, Tropicana Hotel, Las Vegas Nevada; Hours: 10-5 Admission: \$75 for exhibits, \$295 for conference; Attendance: 118,000.
- Contact:** The Interface Group, Public Relations Coordinator, 300 First Avenue, Needham, MA 02194 Tel: (617) 449-6600 Fax: (617) 444-4806.
- Event:** The Second National Conference and Exposition on Electronic Image Management in Government
- Description:** This event will address imaging technologies and systems applications, and government and business implementation issues. Representatives from government agencies, private industry, technology associations and independent consultants will present their views. The event will also feature workshops on document image processing, image information interface and writing and responding to RFPs, and will be accompanied by a select group of companies exhibiting the latest developments in image management.

Date & Place:	November 13 - 16, 1990, Techworld Plaza, Washington, D.C.	Event:	ICCC90
Contact:	U.S. Professional Development Institute (USPDI) 1734 Elton Rd., Suit 221, Silver Spring, MD 20903 Tel: (301) 445-4400 Fax: (301) 445-5722	Description:	India is hosting the 10th biennial International Conference on Computer Communication—ICCC90 in New Delhi. ICC90 is being hosted by the Departments of Electronics and Telecommunications, Government of India. The theme of ICC90—'Technology for Mass Applications,' reflects the belief and hope that benefits of Information Technology will reach millions of people in the nineties.
Event:	NCGA '91	Date & Place:	November 4-9, 1990, New Delhi, India
Description:	This is the 12th annual conference and exposition sponsored by the National Computer Graphics Association dedicated to all applications of computer graphics. NCGA '91 will feature more than 200 exhibitions and a comprehensive conference program geared to major computer graphics user areas.	Contact:	Ms. Saroj Chowla, Organising Secretary, ICC90 Secretariat, CMC Limited, A-5 Ring Road, South Extension part I, New Delhi - 110 049 India Tel: +91(11) 626807, 618189
Date & Place:	April 22 - 25, 1991, McCormick Place North, Chicago, Illinois	= Event:	Fifth Annual European Electronic Hard Copy Consumables Conference
Contact:	National Computer Graphics Association, 2722 Merrilee Drive, Suite 200, Fairfax, Virginia 220321 Tel: (703) 698-9600 Fax: (703) 560-2752	Date & Place:	November 7 - 9, 1990, The Amsterdam Hilton, Amsterdam, Holland
Event:	First Annual European High Volume Electronic Printing Conference	Contact:	Michelle Graczyk, (617) 893-9130 or Rebecca Pesko, (617) 982-9500, BIS CAP International, 1 Longwater Circle, Norwell MA 02061 Fax: (617) 878-6650
Date & Place:	October 17 - 19, 1990, The Amsterdam Hilton, Amsterdam, Holland	Event:	EUROFAX '90 Exposition and Conference
Contact:	Michelle Graczyk, (617) 893-9130 or Rebecca Pesko, (617) 982-9500, BIS CAP International, 1 Longwater Circle, Norwell MA 02061 Fax: (617) 878-6650	Date & Place:	November 14 - 16, 1990, The Krasnapolsky, Amsterdam, Holland
		Contact:	Michelle Graczyk, (617) 893-9130 or Rebecca Pesko, (617) 982-9500, BIS CAP International, 1 Longwater Circle, Norwell MA 02061 Fax: (617) 878-6650 □

Basic, Cont'd. from page 19

impedance. Impedance is the total of all resistances and reactances in the circuit. Unfortunately we can't just add them together algebraically because the reactances have those pesky phase shifts attached to them. If we were going to get into the math of all this, (which we won't), we would have to use vector algebra to find the impedance. (It's a lot of fun if you have a good scientific calculator and know your trigonometry... Hmm... Idea! All of you who really want to know the 'low-down' on vector algebra using polar and rectangular form, write letters to our editor pleading with him to have me write a tutorial on it. He's gonna love me for it.)

Where were we?

Ah, yes. Take a look at Figure 8 again. We can get an idea qualitatively, of how impedance is determined by

seeing the vectors displayed and graphically combined. The phasor diagram shows the values of the reactances and resistance in the circuit in Figure 7. Because the capacitive and inductive components have opposing phase shifts we can vectorially add them to get a resultant, which in this case, is a net inductive or +90° value. This, in turn, is combined with the resistive component to obtain a resultant vector which has a magnitude and angle (θ). This impedance, Z_T , then, can be used with Ohm's Law to determine the current in the circuit, but the phase angle must be taken into account. The quantity of the impedance divided into the AC supply voltage will give the magnitude of the current, and the phase angle, (when properly manipulated in polar form) will give the phase shift between the current and voltage.

Keep in mind that these calculations would be done at a given supply frequency and that for any other frequency the overall circuit impedance, and thus phase angle, would be different.

I've said all of that just to say that: being able to quantitatively predict what is happening in an AC circuit with reactive components is possible, using the required math, and necessary in certain circumstances. I have tried to stay away from the math and still touch on the basics of what goes on in RLC circuits. Of course, there is lots more we could cover but hopefully this will be useful from the broad perspective.

Next month we'll wrap up this series with a look at how resonant circuits work, as well as a general 'clean up' of miscellaneous loose ends on basic electricity. □

The State of Satellite Television

Perhaps one of the most misunderstood areas of high technology, satellite television, is neither as dead as many people think nor as doomed as has been predicted. The video of choice, microwave television is the ultimate tube if you can afford it.

Steve Rimmer

When we moved last fall, the object which involved the most insurmountable transportation problems was neither the freezer, the safe, the antique porcelain or Jones, the collie from hell. The real kicker was the ten and a half foot satellite dish in the yard. I mean, you can live without a freezer and a dog but the thought of trying to do without satellite television is beyond comprehension.

Well, it is for us, anyway.

Satellite television is a reality for many people in Canada simply because they live beyond the range of terrestrial broadcasts and cable. However, for a growing number of people, satellite television is an alternative to available conventional signals. With hundreds of channels and signal quality which is vastly superior to the mud that flows

through cable, a satellite downlink looks like a worthwhile investment.

The next time there's nothing but reruns on the box you might want to consider what it's like to have a few dozen movie channels, an equal number of sports channels, music channels and other special interest channels, as well as numerous local channels from across North America, all on tap whenever you feel like looking at them.

Unfortunately, the superb technology of satellite television has been clouded of late by a lot of infighting and politics. The cable television industry, which is large and pretty well organized, has long wanted to restrict access to downlinked signals. Given the choice between the limited choices and decidedly low fidelity of cable and the joy of satellite television, most of the suits with investments in cable could reliably forecast which way the wind would blow.

In fact, much of the programming downlinked from satellites is intended for cable television companies. Pay services such as First Choice, TSN and Much Music, for example, are all provided to local cable companies by satellite. Having your own dish merely bypasses the cable companies... as well as their noisy line amps, low bandwidth cable, frequent equipment failures, programming swaps, rate hikes and monthly invoices.

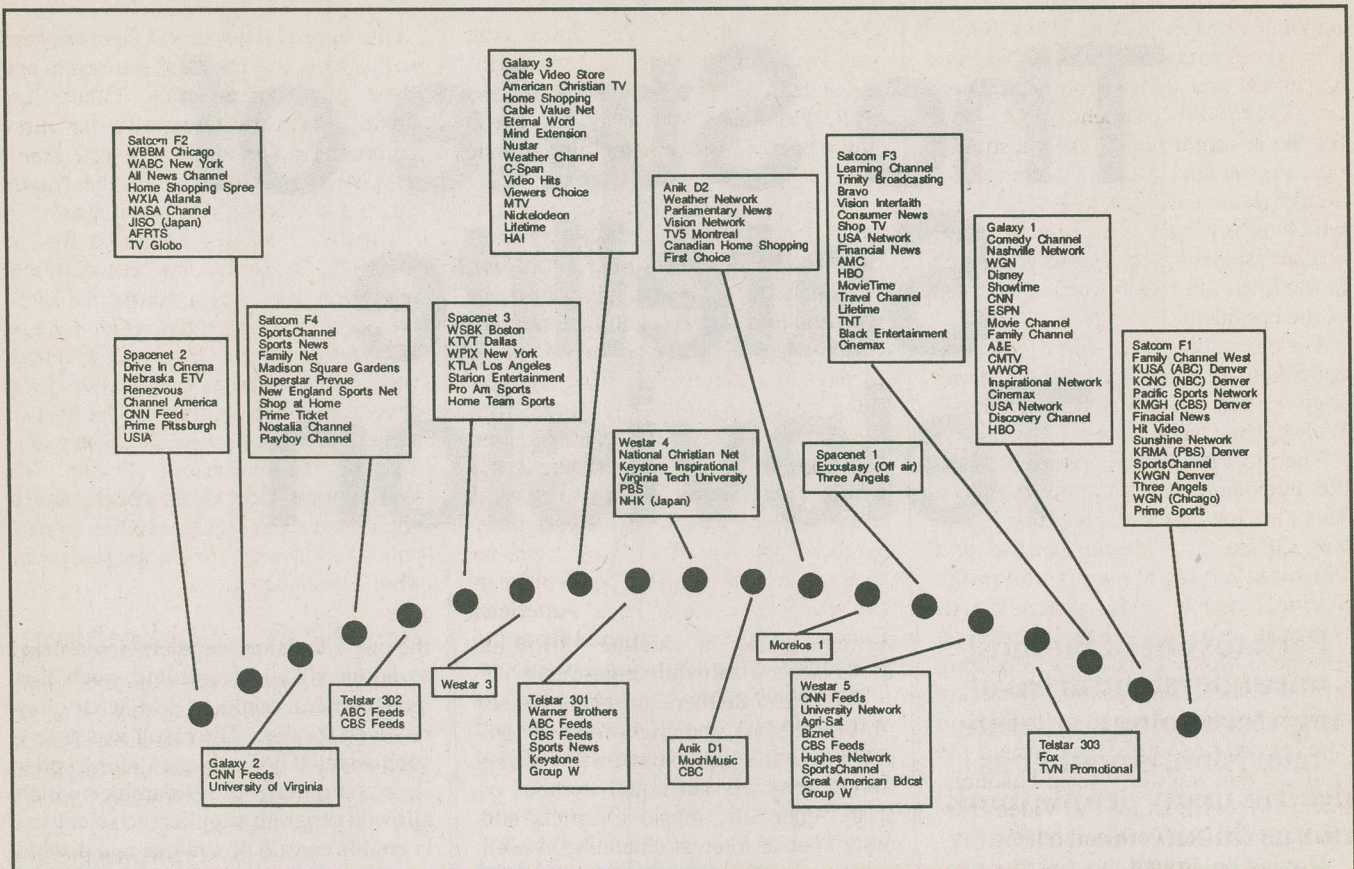
Some time ago the American cable companies banded together to pressure

the pay television suppliers down there to adopt signal scrambling, such that dish owners couldn't use what they received for free. The result was a very sophisticated box called a VideoCypher II, a computerized descrambler which allowed program suppliers to selectively enable certain downlinks and disable the rest for each scrambled signal source. We'll get into the nasty details of this in a moment.

The introduction of the VideoCypher II descrambler was shortly followed by the introduction of the VideoCypher II descrambler cracked ROM, which is really where the story begins. Plug it into a VideoCypher II and all the scrambled signals cease to be scrambled. In fact, it's not nearly this simple, and if the technology is a bit murky the legal situation surrounding satellite television is very nearly opaque. However, if you take the time to understand it you might find that there's a great deal more to television than situation comedies and endless commercials.

Up the Down Link

Before we get deeply into the nasties of scrambling and its attendant mythology, it's probably worth a quick shot at the basics of satellite technology, as well as some overview of what you can find on the waves. You can skip this section and get onto the clandestine bits if you have a general understanding of how the pieces fit together.



An overview of what's available on the C Band Satellite

Television satellites live in a geostationary orbit 22,500 miles above the surface of the earth. Because they move at the same speed as we do, they remain over the same bit of real estate all the time. They communicate using microwave frequency signals. There are two frequency allocations available for satellite television in North America, the "C" band at 3.5 gigahertz and the "Ku" band at twelve gigahertz. The "C" band is currently where most of the interesting programs live, and it's what we'll be discussing for the most part here.

Each C band satellite has a total of twelve frequency channels available to it. Each channel can have one of two polarities, that is, horizontal or vertical. If the receiving antenna, or "probe" of a satellite dish is oriented horizontally, it will receive no energy from a vertically polarized signal. As such, there are actually twenty-four available channels on each satellite, twelve vertical ones and twelve horizontal ones.

As you scan through the channels on a satellite receiver, the microwave an-

tenna out at the dish rotates the probe accordingly. This is called the "polar rotor."

The satellites used by satellite television are positioned about two degrees apart... this isn't universally true, and there are moves afoot to adjust the positions of some satellites to allow room for a couple of additional ones. Because microwaves are exceedingly directional, you can select the satellite you want to receive signals from by pointing a dish at it. The mechanism which moves the dish from satellite to satellite must be able to track the arc of the satellite very accurately if it's to receive them all. Imagine trying to align a twenty-two thousand mile broom handle to a target you can't actually see and you'll have some idea of the technical problems involved.

Contemporary satellite receivers and antennas make most of the fiddly details irrelevant. You can change channels in pretty much the same way as you would the channels on a normal television set. The receiver remembers where each satellite is, what polarity the

signal in question is, how to decode the sound and so on. The only real difference is that there may be a bit of a wait while the dish moves if you want to watch a program which is situated on a satellite far removed from the one your dish is currently pointed at.

Satellite television signals have vastly superior signal bandwidths as compared to conventional terrestrial broadcasts. Properly set up, a satellite receiver need suffer from virtually no picture interference. Satellite video is sent as FM, which improves its ability to reject noise considerably. Satellite audio is usually stereo, and has better bandwidth, separation and fidelity than conventional tube sound.

With everything working well, with a good monitor to display the pictures and a good stereo system to reproduce the sound through, a satellite program will blow away a good commercial video tape and can frequently rival the output of laser discs.

The programming available on satellite television is beyond easy description, and that which I will describe will

inevitably be incomplete. The programming changes constantly as new signals are added and a few disappear. There are lots of "wild"... unscheduled... feeds for the adventurous. There's also a lot on satellite that the cable companies would never dare run, and a lot more which is regional. The regional stuff can be fascinating, as it gives you a look at the local television from other parts of the continent.

For example, one night we discovered that Denver has a topless donut shop called "Debbie Duz Donuts". Weird planet, this.

The most prominent feature of satellite television is its movie channels. There are lots of them, including Home Box Office, The Movie Channel and Cinemax, and lesser known entries like Starion, Drive-In... which seems to specialize in exquisitely bad B movies... American Movie Classic... specializing on old flicks... and so on. There are numerous sports channels, with live and taped sporting events from around the world. There are also music channels, such as MuchMusic, MTV, Video Hits, the Nashville Network and others.

Moving on around the dial there are family feeds such as two shots of Disney... east and west... Nickelodeon, The Family Channel, The Learning Channel, The Life Channel and so on. Every

conceivable religion, sub-religion, cult, sect, faith, denomination and special interest belief seems to have a feed as well, and if you like pray TV you'll never be at a loss for something to tune into.

If you don't like religious programming at all, you might be more interested in the... ahem... adult feeds. Now, you don't watch these things and I don't watch these things and, in fact, nobody actually watches them but they do seem to have the largest following of anything on the waves. They range from the Playboy channel, which is a bit tame and tries to be intellectual about the whole sordid affair, along to several more adventurous feeds. Regrettably for those who like a lot of flesh tones on their screens, the undisputed winner in the game of musical beds, American Exxxstasy, recently vanished from the skies for a while due to legal problems.

As the tale goes, some kids in Atlanta were taping Exxxstasy's broadcasts and selling the tapes at school. Schools are funny about things like that.

In addition to all of the foregoing, there are also numerous feeds from networks, which use satellites to move their programs and news coverage around. Some of these are scheduled, and behave just like regular commercial broadcasting except that the sound and

picture are a lot better and there are gaps in the programs for local stations to add their own commercials. Others are "wild", and are frequently far more entertaining for the things you aren't supposed to see than the bits that finally make it into scheduled broadcasts.

Finally, I should note that just as there's TV Guide for conventional television, there are a number of satellite programming guides which are just as comprehensive. Of course, they're a good deal thicker, as satellite television covers a whole continent. The best of these is a Canadian publication called Satellite Entertainment Guide. It's available on most news stands, and if you're considering a satellite system you should spring for a copy just to see what's really up there.

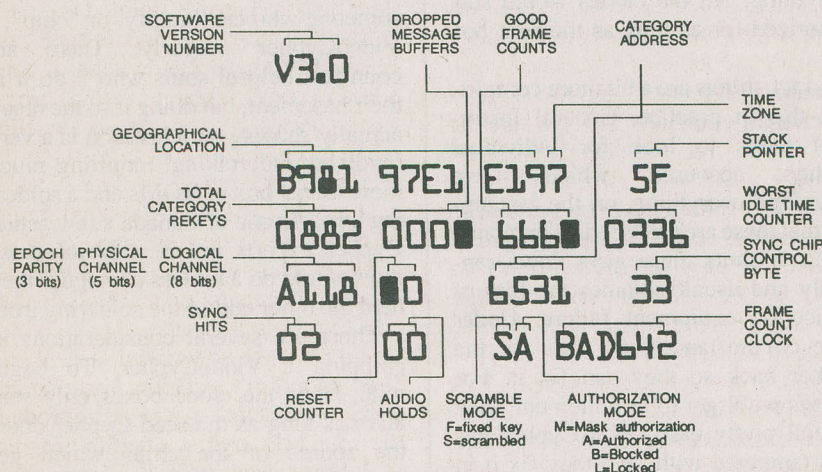
And Now... Scrambling

One of the persistent rumours about satellite television is that it's all scrambled and hence useless. This is about half true. Just about everything worth watching is scrambled, but it's anything but useless.

The most commonly used scrambling system is the VideoCypher II. The hardware is built by General Instrument, the same company which makes many cable television channel converters. The principal of a VideoCypher is fairly easy to understand. Each satellite receiver which is to receive scrambled signals requires a VideoCypher, a box about the size of the average receiver. Contemporary receivers usually have the VideoCypher built in, which makes your livingroom look a bit tidier but doesn't affect the basic workings of the system.

First Choice is one of the few Canadian satellite services which is scrambled using VideoCypher technology, and will serve as an example of how the whole circus works. Allowing that you have your receiver tuned to First Choice's scrambled signal, you would call First Choice with your credit card number and the key number printed on the back of your VideoCypher. Having billed your plastic, First Choice would send a "hit" out over the satellite, buried in the retrace of the video signal, which would tell your VideoCypher to descramble the signal for First Choice. It would not descramble anything else unless those

DIAGNOSTIC DATA



The information in this chart is provided courtesy of db Associates.

As most VideoCypher owners discover, there is a secret diagnostic screen available on all VideoCypher decoders, accessible by pressing the setup button and then the zero key. This screen contains a great deal of information about what your VideoCypher is doing, and is particularly useful should you want to know why a particular channel refuses to descramble.

other signals were paid for and authorized as well.

Likewise, if you cancel the service or just stop paying for it, First Choice can de-authorize their signal on your box. In fact, new hits with new descrambling "keys" must be sent to your box over the satellite datastream at least once a month or everything lapses into silence.

The great majority of the VideoCypher encrypted signals are of American origin. Most of the Canadian services are scrambled using a different sort of encoding system called Oak Orion. There are, in fact, several other, lesser used scrambling systems turning up as well, but these don't really pertain to things that anyone would probably want to watch... you find them protecting closed circuit horse racing and the like.

Home Box Office is one American equivalent to First Choice. In theory, anyone with a VideoCypher could subscribe to HBO, even if they lived in Canada. In practice, this is not so. Home Box Office will not knowingly authorize a VideoCypher located north of the boarder for their services, and to prevent you from pulling their leg on this matter, they use an eight hundred number which cannot be called from within Canada, they refuse to accept credit cards drawn on Canadian banks as payment and they require a believable American mailing address. Obviously if you have American friends or relatives you can probably get around this, but the message is fairly clear. You cannot legally purchase American scrambled signals in Canada.

The feeling among many Canadian satellite television users is that, unable to buy these signal, swiping them isn't really theft of services. To be sure, bypassing the VideoCypher scrambling technology in the States would be clearly illegal, as would it be if one were doing it in Canada to steal First Choice without paying for it. Viewing HBO and all the other American feeds in Canada without paying for them is a much greyer area, and one which is properly left to the individual consciences of Canadians.

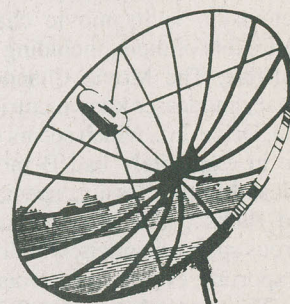
Obviously, this becomes an issue because there *is*, in fact, a way to get around the sophisticated encryption technology of the VideoCypher. While for practical purposes you can't actually crack the DES encryption the box uses, you can arrange to fool the box into thinking that it has been authorized

Much of the information in this feature was provided by

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for things which it hasn't. The process is simple in principal. If the owner of one VideoCypher were to have HBO authorized in the usual way and then copy the ROM and the memory contents of that Cypher to a second Cypher, both Cyphers would think they were authorized. If the initial Cypher had all the available services authorized, clones of it would likewise descramble everything. All the clones would stay authorized for as long as the first box did.

In fact, things are a bit more complex than this in practice. General Instrument tends to look for individual Cypher accounts which have authorized everything, on the assumption that these are the "seeds" for cloned boxes. It shuts these guys down randomly and usually blames the loss of service on equipment failure. Under these circumstances, GI asks for the Cypher back so they can fix it. For reasons we'll get to in a moment, they can tell pretty easily if a Cypher has been tampered with, and they fix it in ways its owner might not appreciate. In the mean time, all the clones of the box will stay permanently dark.

To get around this, "seed" Cyphers actually consist of a fusion of several individual boxes in the transplanted software. The result is that, while the clone Cyphers have everything

authorized, the authorization looks to be spread over four or five actual Cypher numbers and it's not obvious to General Instrument that something's afoot.

Solder and Propane Torches

The hardest part about getting a satellite system going in Canada is finding someone who can modify, or "chip", a VideoCypher properly. There are countless helpful souls who'll do it in their basement, but doing it so the result actually shows you television is a very involved undertaking, requiring much more than a box of ROMs and a soldering iron. As one of Canada's few actual Cypher experts put it, most of those guys would do a lot less damage if they held the other end of the soldering iron.

There are several considerations in chipping a VideoCypher. To begin with, since the clone boxes only stay alive as long as the seed Cypher does, the source of the chips which get transplanted into your system is quite important. It's not at all uncommon to have someone chip your box and only have the result last for a few weeks. By this time, you'll probably find that the guy with your money is history.

Inside Compact Discs

The sword which has beheaded the vinyl monster, compact discs are a fusion of the latest digital technology and a vast library of music that's never quite been heard before. Here's a look at how all those lasers, noise shapers, oversamplers and filters perform their magic.

Steve Rimmer

The world is becoming civilized after all. You can get the Strawbs on CD... albeit, in many cases only from Japan. You can also get much of Steeleye Span, all of Yes, everything Tull ever did... including many hitherto unreleased bootlegs... the Grateful Dead. The list, while not endless, fills a quarterly publication called CD International which is currently just a bit smaller than the Toronto phone book.

You, of course, may well have your own list of "civilized" compact discs.

Hearing music which has been previously released on vinyl once it has been re-released on a compact disc is often like hearing it for the first time. The fidelity and dynamic range of a CD is breathtaking, and one frequently hears things in a good CD which were missing or went unnoticed in vinyl. Complex music with a lot of dynamic range... Yes comes quickly to mind... which got compressed and flattened out

to fit into the confines of LPs years ago seems to spring to life on CD.

If the music of compact discs is inspiring at times, the technology which reproduces it is fascinating. Using hardware which would have sounded like something out of a science fiction flick not all that long ago, it overcomes all the limitations of traditional sound reproduction techniques by trashing the works and starting over.

If easily understood in principal, a digital laser pickup is a bit involved when you get down to talking about the details of the process. In this feature we're going to look at how compact discs work and deal with a few of the more involved techniques which are applied to it, including oversampling and the latest single bit MASH systems. Having read this, you will be able to turn any audio salesperson to a quivering heap by merely speaking.

The Pits

One of the things which makes compact discs so attractive to the people who design compact disc players is that all compact discs are physically identical, save for the actual information encoded in them. Audio information is stored in sixteen bit samples... we'll get to what that means... at a sampling rate of 44.1 kilohertz. A single compact disc can hold 4.3218 megabits of information, which works out to a maximum playing time of seventy-four minutes. As ancient legend has it, the playing time of a compact disc was established by Philips, the creator of the format, who consulted the conductor Herbert von Karajen early in the project's development. Von Karajen suggested that a single disc should be able to reproduce

his arrangement of Beethoven's ninth symphony, which ran to about this length.

The actual data encoded on a compact disc is stored as pits in the aluminum substrate buried in the disc. The pits are about half a micrometer across, and constitute one of the smallest objects in any commercially manufactured device. The pits live in spiral track running from the centre of the disc outwards... that is, the first cut on a CD starts closest to the hole, the opposite of how a vinyl record works. There are sixty tracks of pits in the same space as a single groove of a vinyl disc. In playing a full length compact disc, the pickup travels about three miles.

A compact disk revolves at anywhere from three and half to eight revolutions per second, depending upon where on the disc the pickup happens to be.

Laser light reflected from the aluminum surface of a compact disc is modulated by the absence or presence of pits. In this way, binary information can be recovered from the disc and ultimately reconstructed as music.

In order to get a lot of data on a disc, the information represented by the pits is encoded. The actual encoding process is called "eight to fourteen modulation," and employs something called a "cross interleave Reed-Solomon code" such that if the datastream is disrupted... for example, by some dust on the surface of the disc... the processor in the compact disc player can re-establish its integrity reasonably quickly. Contemporary compact disc players are able to do this in most cases without any audible effects at all, and it's rare that a reasonable amount of

surface dust will affect the performance of a CD.

It probably goes without saying that a compact disc player uses a micro-processor to run the show.

The audio specifications of a typical compact disc player are superb, especially compared with earlier recording media. The frequency range runs from twenty hertz to twenty kilohertz with less than three tenths of a decibel variation. The signal to noise ratio is better than ninety decibels. The stereo separation is better than eighty-six decibels. The total harmonic distortion is less than 0.005 percent. The wow and flutter are immeasurable. These values vary a bit from one player to another.

Compact discs themselves are amazingly rugged and durable. Inasmuch as nothing touches their surfaces... save perhaps for an errant finger from time to time... they need never wear out. They're impervious to most environmental effects, save for really intense heat and small tactical nuclear weapons. Some years ago, a rumour was started... perhaps by someone with an interest in a vinyl record pressing plant... that compact discs deteriorated with age. As someone at Philips put it then, if you keep your CDs in boiling water under hard ultraviolet light for a few years, you will invariably notice some deterioration.

Stored under less extreme conditions, they will not only outlive their original purchasers, but any reasonable number of descendants as well.

It's probably worth noting that in addition to aluminum based compact discs, there are a limited number of discs available with their digital information recorded as pits in gold. A gold disc costs about seventy dollars compared to about fifteen for an aluminum version. The sound reproduced by gold discs is said to be better, inasmuch as gold can more accurately reproduce the shape and position of the data pits, being a denser metal. I've only ever had the chance to compare one of these things to its aluminum counterpart... I borrowed a copy of the Mobile Fidelity gold pressing of Tull's *Thick as a Brick*. With a bit of imagination one could barely detect something different about the way the high end was being reproduced, but it would be beyond me to say that the gold disc sounded better.

It would be way beyond me to say that the gold disc sounded fifty-five dollars better.

Sampling and Oversampling

In sampling sound, an analog waveform is broken down into a series of discrete quantities over time. If enough samples of a waveform are taken, the resulting stream of numbers will describe it accurately enough to allow it to be subsequently re-assembled so as to be indistinguishable from the original.

There are a number of things to be considered here. First of all, if the frequency of the audio being sampled and the frequency of the sampling start to approach each other, quite a lot of interference or "aliasing" will occur. Compact discs are sampled at a little more than twice the highest audible frequency to see that this doesn't happen.

Secondly, the samples must be stored with enough resolution to allow the sampled waveform to be accurately reproduced, even at very low signal levels. Early digital music systems, which typically generated sound with eight bit samples, suffered from very "crunchy" sound when the volume was turned down for this reason. Compact discs are sampled with sixteen bit numbers. This means that a compact disc can reflect 65535 discrete volume levels.

In fact, quite a lot more than basic audio samples are included in a compact disc's datastream. There are also synchronization words in there, sub-code data, parity data and so on. The music data does not actually exist as an uninterrupted stream at all, but is stored in "frames" of 588 bits each.

Because there are mechanical tolerances in compact discs, it's not terribly practical to read them with a single laser. The hole in the centre of a CD can be eccentric by as much as three hundred micrometers, which is a lot of real estate for pits that are only half a micrometer wide. As such, single laser tracking is a bit unreliable... although many early CD players were designed this way. Contemporary players use three beams.

A three beam pickup actually only has one laser... its single beam is split into a central beam for data and two weaker beams for tracking. The central beam rides over the pits of a CD while the two exterior beams run along side the pit tracks. The electronics of the player can thus adjust the pickup location to keep the central beam accurately tracking the compact disc pits.

One of the most misunderstood phrases in compact disc technology is that of "oversampling." Nobody seems to know what it is, save that more of it is arguably better than less. In fact, it has to do with the minimization of the noise generated in the sampling process, what is called "quantization noise."

When you break an analog signal apart into samples and then reconstruct it, the result will not be a smooth waveform, but rather a series of steps. The harmonic components of these

Compact discs themselves are amazingly rugged and durable. Inasmuch as nothing touches their surfaces, they need never wear out. They're impervious to most environmental effects, save for really intense heat and small tactical nuclear weapons.

steps are all pretty high, and in theory running the reconstructed signal through a sharp low pass filter would remove all the high order energy. In practice it's not as easy as this. Analog low pass filters introduce unwanted phase shifts, frequency perturbations and so on, all of which are exactly what digital sound is intended to do away with.

The way around this is to handle the filtering digitally as well. The technique used in compact disc players is called a "transversal" filter, which is a sequence of delay lines and multipliers. This has the effect of attenuating noise energy which is closer to the audio spectrum, or, rather, moving the worst of it further away where it's easier to deal with.

If you delay the digital data coming from the CD player's pickup... after it has been decoded and such... by one sample period and multiply it using a twelve bit coefficient, the result will be

effectively a twenty-eight bit sample... an "oversample." Oversampling through four samples will give you the effect of sampling at 176.4 kilohertz, rather than the usual 44.1 kilohertz. This is what is usually found in contemporary compact disc players... "four times oversampling." The quantization noise likewise moves up in frequency by a factor of four, which makes it very much easier to remove without the use of particularly sharp filters.

The resulting quantization noise is further "shaped" by taking the least significant fourteen bits from each twenty-eight bit sample, delaying them by one sample period and subtracting them from the next sample in the stream.

MASH Technology

The newest selling feature of compact disc players is a combination of single bit digital to analog conversion and what is called "multiple stage noise shaping," or a MASH filter. This has been turning up in Technics' equipment recently.

The concept of a single bit digital to analog converter is an approach to minimizing the inaccuracies which result in

conventional digital to analog converters, the circuits which take the digital samples of a compact disc player and turn them back into sound. Because a sixteen bit converter has so many discrete output levels, it's exceedingly difficult to manufacture one with all the levels precisely the same. This can produce measurable distortion... at least in theory... as signal levels approach and cross the zero point.

A single bit converter avoids all this by running very, very fast, and essentially combining all sixteen bits one at a time. Because each bit carries the same weight in this arrangement, errors in quantization are reduced.

The MASH filter which Technics uses is tied to its single bit converter technology. It uses delay line noise shaping, as we discussed earlier, but it does so one bit at a time. The result, in conventional terms, is an effective oversampling rate of something in excess of three hundred times.

But Can You Hear It?

It might well be argued that there comes a point in the evolution of compact disc technology wherein humans can no

longer hear the improvements and only large corporations and small Arab sheikdoms can afford instruments capable of detecting them. I was recently disappointed to find that when patched through the stereo, my very expensive Technics CD player and my wife's portable CD box from Eatons sounded pretty nearly the same.

Of course, the Technics player looks so much more sophisticated...

One of the things which the detractors of compact discs will frequently entertain is the thought of having to replace a lifetime's worth of album collecting. While certainly an expensive undertaking, you might want to consider being able to hear all that vinyl again for the first time, pristine, ageless and better than it ever sounded, even when it was new. A two hundred dollar CD player from Canadian Tire can outperform a two thousand dollar turntable.

Finally, your albums don't have to actually die. Their covers make attractive wall decorations and the vinyl itself has a multitude of uses. Applications in archery, skeet shooting and the exercising of large dogs all come quickly to mind. □

Satellite, *Cont'd from page 38*

The good Cypher chippers usually charge about five hundred dollars a pop, but the results will last for a year to eighteen months and they'll re-authorize or "touch up" your box for twenty-five to fifty dollars.

The real consideration in finding someone to chip your Cypher isn't really involved in the software. It concerns epoxy. Once General Instrument realized that their unbreakable technology had, in fact, been broken, they attempted to prevent tampering with individual cyphers by potting their processors and ROMs in epoxy. Virtually all Cyphers, including those built into receivers, have large green blocks of plastic around the good bits. Before one can deal with the data for such a system, one must remove the epoxy.

There are all sorts of ways to remove epoxy from a VideoCypher, and almost all of them are violent, frightening and ultimately reduce the mean time between failures for the circuitry to something on the order of a minute and a half. There are people who've developed techniques for safely removing the epoxy from a board... the aforementioned Cypher experts... and these guys are fascinating to watch. Someone who knows what he's doing will know, first of all, where in the epoxy to excavate and then just how to remove the plastic without damaging any of the electronics within.

Amateurs tend to go at the effort with power grinders, propane torches, cold chisels and such. Most often, these

approaches will trash your Cypher beyond any hopes of repair. One of Ontario's leading Cypher repair places, db Electronics... there's an ad for them around here... has a gallery of the charred, skeletal remains of boards which have been chipped by amateurs.

Eye in the Sky

While it has been complicated somewhat by the political issues surrounding it, satellite television is inarguably worth it. If you have a backyard suitable for a dish, a few grand to sink into the works and a functional television set, you will wonder how you ever got along with broadcast or cable TV as soon as you get the whole works going.

The VideoCypher issue requires a bit of care, but it's not a problem so long as you seek some knowledgeable advice and understand the pitfalls.

You might well ask about the permanence of a situation as seemingly funky as the one surrounding Cyphers. In fact, such a question is a good filter for honest Cypher chippers and satellite dealers. The dance of the VideoCyphers has been going now for about five years, and it will probably continue to do so. On the other hand, GI could have one more trick in its arsenal and shut everybody down tomorrow. Legislation could be passed which would make the Cypher situation in Canada wholly illegal. The American satellite

See Satellite, Cont'd. on page 46

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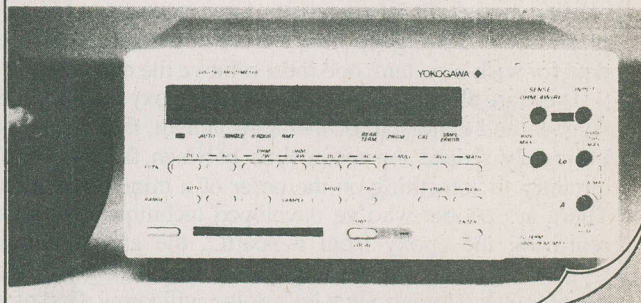
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Digital Radio: The Sound Of The Future

Current developments on the quality of worldwide radio sound for the future.

JOHN SWINIMER

Within 10 years, Canadian radio listeners could be treated to compact disc sound quality on all their radio stations.

The project, called Digital Radio: The Sound of the Future, is a joint venture of the Canadian Association of

This exciting technology really is the wave of the future, according to the Canadian Association of Broadcasters President, Michael McCabe. It has the potential to put local and national radio services in Canada at the top of the sound quality heap.

The source of Digital Radio is based on very short radio waves, similar to those on present FM radio dials, but capable of much better quality. In Digital Radio, the radio wave carries a stream of pulses of the type that form the basis of computer signals, and they in fact mark the entry of computer tech-

have occurred in Rennes, Geneva and Munich.

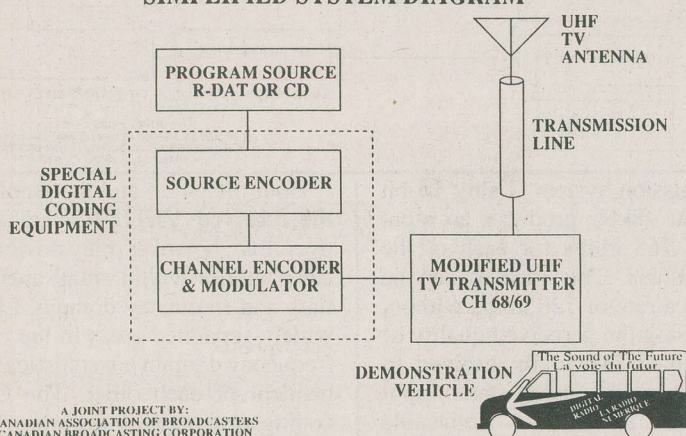
The introduction of this new type of radio source will mean that, for the first time, the capability exists to provide a quality of sound on radio never before achieved. It will also mean that this quality will be obtainable on all new digital radios, whether they are used in homes, vehicles, or as portables.

The sound quality will compare to, and be virtually identical with that of compact disks and digital audio tape now currently rising in popularity in North America and Europe.

Enhancing all types of radio programming, Digital Radio will allow reception in areas where both the present AM and FM bands are subject to interference of many different natural and man-made sources. Digital Radio is not susceptible to the interference that often causes radio stations to fade out, to conflict with each other, and generally become difficult to capture — especially in large cities, in the mountains or in other areas where there are obstructions to radio signals.

Digital Radio is considered to be a revolution not only for the listener but for the broadcaster as well. The computer-based technology will allow more than a dozen stations to share a single transmitter, broadcasting along one wide band on the radio spectrum and covering the whole market area they are licensed to serve with unmatched stereo quality. The fact that many stations will be able to share the same transmitter will also substantially cut transmission

DIGITAL RADIO DEMONSTRATION SIMPLIFIED SYSTEM DIAGRAM



Broadcasters, Canadian Broadcasting Corporation and Communications Canada. It features the first digital demonstrations outside of Europe.

nology into the realm of radio broadcasting. Although not to be implemented in this country for some time, successful experiments in Digital Radio

costs, permitting more funds to be directed at programming. Digital Radio is also equally suited to satellite transmission, using the same receivers as required for reception of terrestrial transmissions.

If the old AM/FM distinctions will no longer apply, a new course of regulatory changes can be expected. The most immediate challenge is the upcoming World Administrative Radio Conference (WARC) in 1992, which will deal with this issue. In preparation for this conference, broadcasters will be working toward a common goal on the part of all sectors of the Canadian industry — the private broadcasters, the CBC and the Department of Communications — to ensure that the 1992 conference will take steps to allocate specific parts of the transmission, not only in Europe, but also in North America. They will also discuss the setting of international standards for digital radio transmitting and receiving equipment. The adoption of these standards will allow large scale manufacturing of digital radios resulting in reasonable pricing for broadcasters and consumers alike.

The first demonstrations in North America of a terrestrial, wide-coverage, Digital Radio broadcasting system have attracted considerable interest from technical personnel working in broadcasting, related industries and government.

The only Digital Radio source and channel encoding systems that have been developed to the extent that actual prototype equipment can be made available for testing and demonstrations are those of the European EUREKA 147-DAB Project. Arrangements were made between the Canadian project sponsors and the two principal developers of encoding and decoding equipment — the Centre Commun d'PSQRstallation service. The loan of a field strength meter, a frequency synthesizer, and a spectrum analyzer was arranged with Rohde & Schwarz Canada Inc.

System Description

The terrestrial Digital Radio transmission system is shown in the accompanying diagram. The following descriptions provide basic information on each block so that a general understanding of the system operation can be gained.

Program Source

For the purpose of the recent demonstrations, audio programming originates from an R-DAT or CD player capable of producing a digital output of pre-recorded music or other material. This unit also serves as an analog-to-digital converter when regular broadcast material is injected into the system for A-B quality comparisons between VHF-FM and UHF-DR broadcasting. A Sony DFX 2400 rate converter has been used to produce the 48kHz sampling rate required by the source encoder.

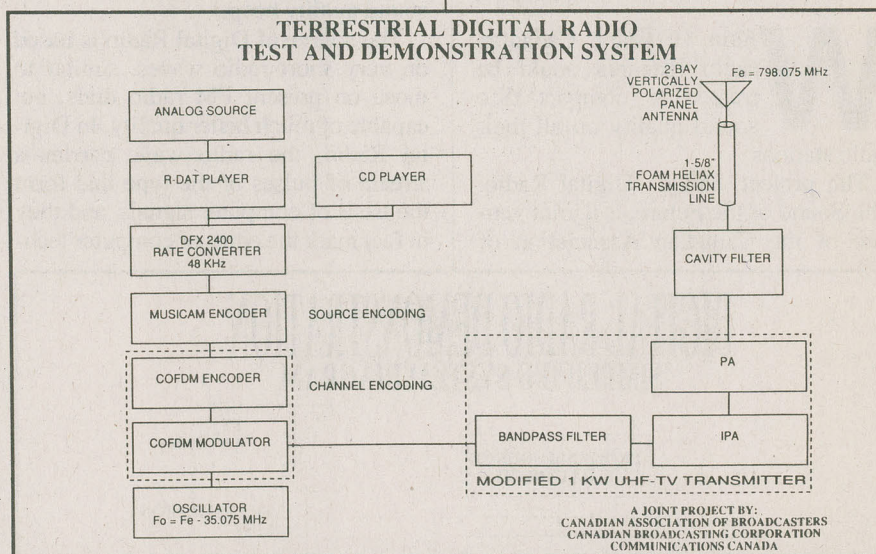
Source Encoder

The digital programming material is fed to the MUSICAM source encoder. This stands for Masking pattern adapted Universal Sub-band Integrated Coding And Multiplexing, developed by the CCETT and IRT as part of the EUREKA Project 147. The system reduces the bit-rate of the audio signals in order to conserve the bandwidth in

properties of the human ear. Based on proven fact, the ear cannot perceive low-level sounds that are masked by others of similar frequency and which are essentially time-coincident. If these sounds can be separated and not transmitted, the decoded audio at the receiving end will not be affected adversely; however, eliminating these sounds reduces the quantity of information that must be delivered, and consequently the data bit-rate. The result is better sound quality.

Channel Encoder and Modulator

The output of the source encoder is fed to the COFDM (Coded Orthogonal Frequency Division, as developed by the CCETT as part of EUREKA Project 147) channel encoder and modulator. The principal purpose of this portion of the system is to code the digital audio signal so that multipath and fading, severe problems in mobile VHF/UHF radio reception, can be overcome at the receiver.



the transmission system. Using 16-bit sampling at 48kHz produces an input bit-rate of 768 kbit/s for each of the stereo channels. This method can be reduced to a rate of 128 kbit/s without compromising the perceived quality of the signal that is eventually received. In other words, a CD-quality stereo input signal will suffer no noticeable degradation when transmitted through the system, even though the source encoder reduces the initial bit-rate by a factor of 6-to-1.

The bit-rate reduction scheme takes advantage of the psycho-acoustical

Both the phase and the amplitude of the received VHF/UHF signals vary over time; however, they do not change substantially within small areas in the time and frequency domain. Likewise, widely-separated areas in the time and frequency domain are statistically independent of each other. The COFDM coding system takes advantage of these two factors to improve signal reception reliability.

This is achieved by distributing the audio data stream over 448 narrowband 4-PSK orthogonally modulated carriers, which are spread over 7 MHz of

available rf bandwidth at an IF of 35.075 MHz. The IF signal can then be heterodyned to the desired VHF/UHF transmitting channel using an external (very stable) oscillator.

The orthogonal modulation technique provides a high spectrum efficiency. This coding/modulating technique ensures that the DR receiver can virtually always retrieve sufficient data to re-construct the original audio signal, since the probability of equivalent selective fading occurring simultaneously at widely-dispersed carrier frequencies is very low. Multipath echoes that are received within a reasonable time delay are used by the system as an alternate source of missing information, and make a positive contribution to reliability.

The MUSICAM/COFDM system used for the demonstrations required 7 MHz of rf bandwidth for 16 stereo channels. The required bandwidth may be reduced to 4 MHz in future versions. The remaining 15 inputs are fed by a test signal that simulates the normal spectrum of broadcast program audio.

The combination of source and channel coding schemes means that the channel re-use factor for this Digital Radio system in an operational configuration can be high. This can be achieved because the system can operate with carrier-to-interference ratios of only 8-9 dB, as opposed to the usual 26 dB in conventional FM broadcasting.

Transmitting Installation

The transmitter portion of the system consists of a modified Thomson-LGT 1KW UHF television transmitter, with appropriate input and output bandpass filtering added. Since the COFDM modulator produces a low-level on-channel rf signal, only the IPA and PA rf stages of the UHF transmitter are utilized. The power level can be varied, and outputs of up to 500 watts have been used in experiments and demonstration transmissions.

The transmitter operates from 794.5 MHz to 801.5 MHz with a centre frequency of 798.075 MHz. (This spectrum is allocated to UHF-TV channels 68 and 69.) It is connected to 91m of 1 5.8 foam-dielectric Heliac transmission line, having a loss of 2.1dB. The antenna consists of 2 bays of verti-

cally-polarized Kathrein UHF-TV panels mounted at 90 about 76m above ground. The panels are configured to produce a tulip-shaped directional horizontal radiation pattern having a maximum gain of 11dB, directed to the North. This description applies to the Ottawa transmission site. Different antenna heights and transmission line lengths may be utilized at other sites.

Demonstration Vehicle

The reception end of the Digital Radio system is contained in the demonstration vehicle. The vehicle consists of a modified Blue Bird 15-passenger school bus, with a Ford Econoline 350 chassis and a diesel engine. The actual guest capacity of the bus is from 10 to 12 persons, given the space required for the demonstration equipment, the driver, and equipment operator.

The Digital Radio signals are received on a vertically-polarized, roof mounted omnidirectional whip, similar to a cellular radiotelephone antenna. The receiving equipment consists of a UHF Digital Radio receiver, a COFDM decoder, and a MUSICAM decoder, the output of which is fed to a high-quality amplifier. This in turn drives a speaker/headphone arrangement so that guests can make critical assessments of sound quality. A conventional FM tuner is also provided so that simulcast Digital Radio and FM broadcasts can be compared. All of the equipment is powered by a 1KW inverter operating from the 12VDC bus electrical system.

Experimental Program

In addition to serving as a means of demonstrating digital radio, the technical installations are being used to conduct certain scientific and engineering experiments. Having a complete, functioning Digital Radio broadcasting system in the UHF band makes it possible to gather information that will be valuable in planning a future permanent service.

Gap Filling

Since the COFDM channel encoding system makes good use of reflected signals, experiments are being conducted to deliberately create multipath for the purpose of filling identified coverage holes. This involves the use of very low power re-broadcasters, known as gap-

fillers. These installations receive the signal of the main station, using a directional antenna at an unobstructed location. They then amplify the signal and re-transmit it, using another directional antenna, into the coverage gap.

Care is taken to avoid feedback in the amplifier by isolating the receiving and transmitting antennas. It is expected that this concept could also be used to extend a Digital Radio service to a distant locale that is not covered by the main transmitter. The principal advantage of this scheme is that no additional spectrum would be required for this service extension.

Single-Frequency Networking

The previously mentioned concept of on-channel rebroadcasters raises the possibility that radio network licensees, such as the CBC, could operate a Digital Radio service over a wide area, utilizing the same channel everywhere. Mobile receivers tuned to a particular channel would make a smooth transition as they are moved from one coverage area to another. The feasibility of this concept will also be verified if time and equipment permit.

Direct Satellite Digital Radio Broadcasting

The system assembled for these experiments and demonstrations is terrestrially-based. However, it appears feasible to consider the benefits of eventually having a complimentary direct satellite digital radio service. This would involve transmission of similarly-coded signals from a satellite, such that the same receiving equipment could be used by the public for both terrestrial and satellite reception. Some experiments are planned with the terrestrial installation to simulate satellite reception, for the purpose of testing this concept.

Digital Radio Consequences

As this new technology becomes more widely available, new means of broadcasting methods will come into play. The key is that new digital studio hardware can be phased in as the equipment industry can supply it and as the broadcaster can afford it. Equipment will be replaced in the normal deprecia-

tion/replacement cycle. No current hardware will be instantly obsolete. Based on proposed studies, operating costs will be lower than those currently experienced due to the fact that Digital Radio technology needs less powerful transmitters than the current AM/FM program transmission.

Digital Radios will be completely non-compatible with current AM and FM radios. Such receivers are more complex, containing many more integrated circuits and other devices than exist in AM and FM radios. To take advantage of the improved quality, listeners will have to purchase new receivers. However, broadcasters would continue to simulcast their programming on the AM and FM bands until a majority of listeners have purchased new digital radios voluntarily.

Spectrum Allocation Matters

If a quantum leap is to be made in the technical quality of radio broadcasting for the future, it will be necessary to consider where in the radio spectrum a new digital radio service could be implemented. It is expected that this issue will be resolved at the next World Administrative Radio Conference (WARC), to be held in Seville, Spain in 1992. The technical information garnered from the Digital Radio experiments in Canada in 1990 will no doubt make a valuable contribution to the studies that must be undertaken in preparation for WARC 92.

This exciting new breakthrough in radio technology will put Canada on the leading edge of sound achievement. Many new and innovative challenges await the nation when radio sound will go digital. The audience is listening.

John Swinimer, editor of Computers in Education and Government Purchasing Guide, listens to the radio constantly and is waiting patiently for digital sound quality. □

Satellite, Cont'd. from page 41

feeds could all switch to a new scrambling technology next week. None of these things are terribly likely, but anyone who's honest about the whole party will inform you of the possibilities.

There is, in fact, a bill before parliament as of this writing which may (or may not) speak to some of these issues.

There are a few other things worth mentioning. Most of the reputable people who chip Cyphers will urge you to arrange a subscription to First Choice. In most cases you won't need it... First Choice will be authorized whether you pay for it or not... but doing so will remove you from any potential future accusations that you're involved in the theft of services you could have paid for. The cost... about a hundred and fifty dollars a year... is fairly reasonable, and is no more than you would pay for First Choice on cable.

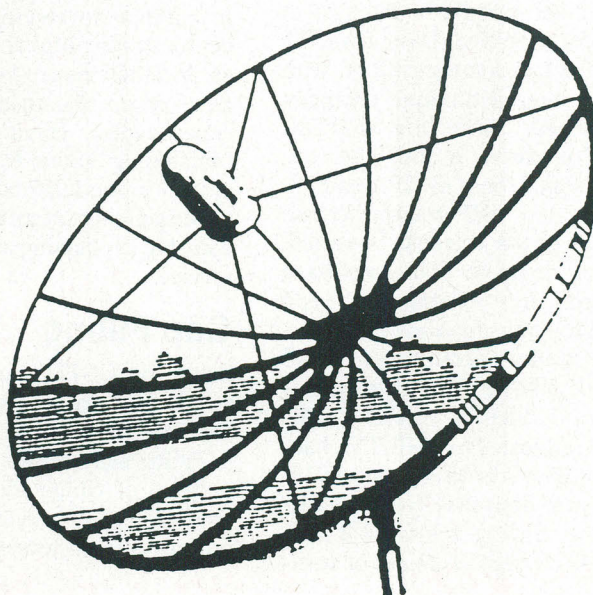
Certainly if you don't subscribe to First Choice this way, *don't watch it*. First Choice is currently situated on satellite Anik D2, which has nothing

else of any real interest on it. If you don't pay for First Choice, don't program Anik D2 into your receiver.

Secondly, you will probably hear about something called the VideoCypher II Plus, a new generation of VideoCypher technology which General Instrument announced last year. So sophisticated and unbreakable, its circuitry was released without even the protection of an epoxy casing. I'm told that this one, too, has fallen to the chippers.

There's something very philosophical in all this, of course... the zen of codebreaking.

Satellite television is the ultimate high technology entertainment medium... and, in fairness, this article has only begun to discuss the range of things it makes available. It's better than super VHS, laser discs and a year's free movies at your local video store because it's all live. It comes from everywhere, and you can really take control of what you watch. □





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Jerry's a good driver. But this time he's had one too many and the thought of him behind the wheel makes you nervous. Can the gang persuade you to get in the car anyhow or will you stick by your guns and say no?

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instead. Better still, Jerry should leave the car parked then everyone could share a cab home.

If your friends are really your friends they'll thank you, not put you down, for pointing out the dangers of drinking and driving. What you're really doing is caring about their safety as well as your own. And isn't that what a friend is for?

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